SCIENTIFIC AMERICAN

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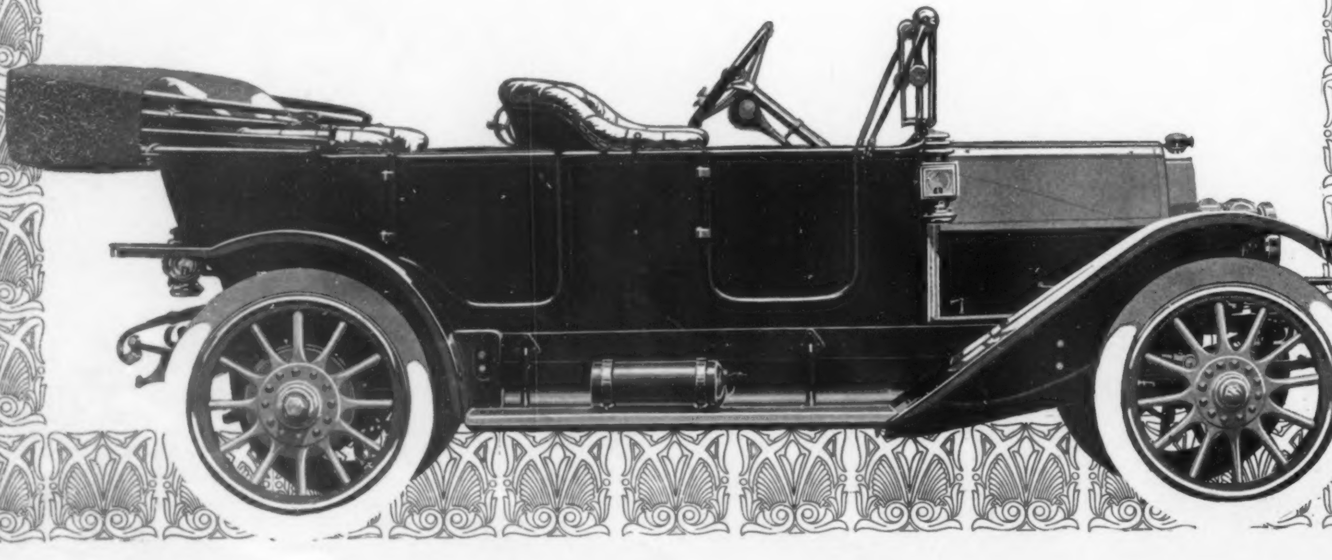

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The Düsseldorf Exposition of City Building

By Our Berlin Correspondent

TOWN planning as an art is of quite recent date. In olden times towns were mainly shelters against the attacks of outside foes and accordingly were encompassed by walls into which the inhabitants of the surrounding districts would crowd on the approach of the enemy.

As there are now no walls to hinder the expansion of cities, and modern rapid transit systems permit of covering great distances quickly and cheaply, modern cities are seen to extend their suburbs like tentacles a long way into the country, deriving from the latter an inexhaustible store of vigor and health. The country used to come to the town; now the town goes out into the country. Moreover, the crowded network of narrow streets devoid of any trace of verdure is more and more replaced by regular systems of broad and well planned streets, leaving plenty of space for private gardens.

In view of the increasing importance attached to this problem the Exposition of City Building, organized by the city of Düsseldorf on the Rhine, would seem to be of more than passing interest. The idea of this exposition had been suggested by the decision of the City Counsel to call for a general competition for the building of Greater Düsseldorf, the outcome of extensive incorporations of neighboring communities. It may be said that Düsseldorf, the old and quiet town of art and gardens, had, with surprising rapidity, become an industrial center of nearly 400,000 inhabitants. It was intended to exhibit such plans of modern city builders as would be received in connection with this competition, but in order to avoid any one-sided presentation of the subject, the municipality invited all the more important communities of the western provinces to participate in a city exposition comprising all fields of communal life. This invitation was sent out to all townships having more than 10,000 inhabitants in Rhenania, Westphalia and Hessen-Nassau, as well as to some firms more directly connected with communal life. The Düsseldorf Exposition thus is a joint intercommunal enterprise of the towns and cities of Western Germany which in its conception is entirely new. About 600 exhibitors are showing nearly 4,000 different objects grouped under City Building, Sanitary Arrangements, Hospital Management, Civil Engineering, and Industry.

With its historical and modern town pictures, its models and photographs of remarkable monuments and buildings, old and recent, its reproductions relating to the designing of streets and drainage plants, gas and water supply, the exposition is nothing short of an illustrated history of German towns and is bound especially to appeal to those concerned with the character of modern towns and their manifold tasks from a social, educational and sanitary point of view.

The Department of City Building presents in 37 rooms a number of solutions of town-planning problems. The town of Hamm, Westphalia, illustrates by means of two relief maps corresponding to 1910 and 1916, respectively, the contemplated improvements of its street system entailed by the partial shifting of the river Lippe and the construction of the Lippe canal, the costs of this improvement work are estimated at $7,000,000. A large model illustrates the street improvement recently commenced in the Hansastrasse at Dortmund.

Exhibit of the municipal schools of domestic science.

Model of the city of Hamm and its environs.

Suggested plan for a town with plenty of garden space.

Display of a plant that utilizes refuse slag.

THE DÜSSELDORF EXPOSITION OF CITY BUILDING

Another scheme shown at the exposition, which is likely to arouse universal interest is the contemplated installation of a network of roads 21 meters (69 feet) in minimum width, affording a connection as straight as possible between the various centers of industry, and dealing with street car as well as carriage traffic. These roads are even to be continued beyond the industrial district proper, as far as Aix-la-Chapelle and Cologne and the Sieg district.

An important department coming under the head of "Sanitary Arrangements" is that of drainage plants and the purification of sewage. Hamburg had long been the only German town having a well controlled drainage plant, until in the sixties of last century the towns of Frankfurt-on-Main, Stettin, Danzig, Berlin and others at last realized the importance of such installations.

Included in the exposition are all the different systems of drainage, many schemes, general and specified, of plants of different dimensions on the mixing and separating systems, mechanical cleaning and settling tanks as well as plants designed on the biological and oxidation processes, special plants on the Emscherbrunnen system and some minor settling plants for industrial works, hospitals, etc.

A kindred problem is the cleaning of streets and the refuse disposal. The divers ways and means available in this connection are most adequately illustrated, thus affording to engineers a welcome opportunity of study and to the man in the street an interesting insight into a field yet insufficiently known. The city of Dortmund, for instance, shows an installation for the collecting and loading of domestic refuse destined to be transported to some distance and for the cleaning of dust-bins on the alternating system. A large-scale refuse sorting plant connected with agricultural operation is exhibited by a refuse utilization company. Pictures and actual models of refuse destructor plants are shown by some of the most important cities of Western Germany and by many engineering firms.

Communal and private hygiene, inclusive of the installation of baths, sanitary plants, heating, disinfection, school hygiene and other sanitary arrangements, constitute another department. Maps, illustrations and models of widely differing bathing establishments from the simple douche to the large swimming tanks and the most modern achievement, viz., riverside "beaches," are among the more important exhibits of this part of the exposition. The economical and hygienical disposal of the dust of our dwellings has for the general health an importance which cannot be overrated.

Other exhibits of interest are those relating to the destruction of rats and gnats and on the other hand to the protection of animals. The various arrangements for the treatment and prevention of disease form a special group showing in a most comprehensive manner the management of modern hospitals, as well as the provision made for the prevention of epidemics and the protection of infants.

The department of Civil Engineering comprises plans and models of public and industrial buildings, railways, bridges, etc. The department of Industry finally reviews the development and status of the industry of Western Germany in its various branches and therefore resembles the ordinary industrial show.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Good Roads and National Defense

WHATEVER benefits of a military character may be derived from the recent army maneuvers (and they will doubtless be many) the operations have had the much desired result of drawing attention forcibly to the necessity for good roads as a part of the system of National defenses. The *Army and Navy Journal* states that there was one opinion shared unanimously by Army and National Guard officers who took part in the Connecticut maneuvers. It was that the roads of that State, with the exception of some of the main turnpikes, are not what the roads of so old and advanced a State as Connecticut should be. We are told that in the event of war and a heavy fall of rain, the side roads would be almost as impassable as the Virginia dirt roads were during the Civil War. The necessity for good roads is emphasized by the fact that the country is hilly; and those of us who have had occasion to travel through the State know that some of the hills are both steep and long.

The defensive maneuvers in Connecticut proved once more that good highways are absolutely necessary for the rapid disposition of troops. Napoleon understood this fact, and his system of military roads is one of the finest monuments left by this soldier-engineer. It is not to the point to say that railroads, which were unknown in Napoleon's day, are available now; for while the railroads are excellent for the conveyance of large bodies of troops quickly over long distances, we must remember that the majority of the movements of troops, especially in tactical movements, must be made over the State and country roads.

The Gordon Bennett Cup Race

IF the Gordon Bennett Cup race taught us anything it taught anew the lesson of America's backwardness in aviation. Prizes of ten thousand and fifteen thousand dollars had been offered by clubs for a cup defender. The response was discouraging to say the least. Gallaudet made a splendid effort to comply with the Aero Club of America's conditions by designing a machine which is in every way a credit to American ingenuity, but which sustained a severe accident a few weeks before the race. That a nation of ninety million people supposedly possessed of considerable wealth and interested not only in sports but in the most recent developments of mechanics should produce but one Gallaudet is hardly to its credit. But when that nation is more or less in honor bound to live up to the traditions of a Langley, who gave the world the first motor-driven aeroplane model, and of two Wright brothers, who gave the world the first man-carrying motor-driven flying machine, what can be said in defense?

To France belongs the credit of having displayed the greatest interest, not only in the Gordon Bennett race, but in the industrial side of aviation as well. From the very beginning the Gordon Bennett race has been a kind of milestone which marked the progress of French designers. True, in years past the race has been won by Englishmen and Americans, but the French really deserve the credit; for, with one exception, their machines and their motors carried the pilot to victory. The only formidable competitors of Curtiss in the now historic contest of 1909 were a Blériot and an Antoinette machine. In 1910 the Blériot and Antoinette monoplanes were again in evidence, but improved in design and equipped with motors of higher power. In 1911 a Nieuport, a remarkable machine in every way, carried off the honors. This year the Frenchmen appeared on the scene with two Deperdussins of 140 and 100 horse-power, respectively, and a Hanriot of 80 horse-power. In the elimination trials held on July 13th last, these three machines developed amazing speed. The 80 horse-power Hanriot made 145 kilometers (90.09 miles) per hour; the 100 horse-power Deperdussin, 164.338 kilometers (102.11 miles) an hour; and the 140 horse-power Deperdussin, piloted by Vedrines, 169.81 kilometers (105.51 miles) an hour. Even the machines of Grahame-White and Hamel are French; for Hamel's monoplane is a true Blériot and Grahame-White's a Nieuport, for all its English pedigree.

It seems distinctly wrong to credit the man rather than the machine for a Gordon Bennett victory. Without disparaging in the least the courage and the skill displayed by the men who pilot monoplanes that cleave the air at one hundred miles an hour, surely it would be more fitting if the designer and manufacturer were to receive some of the credit. Why should not the rules stipulate that each country shall be represented not only by one of its citizens, but by a citizen seated in a machine made in that country?

A New Parcels Post

IT is gratifying to note that at last the Congress, before its final adjournment in August, passed almost unanimously an amendment (Section 8) to the Post Office Appropriation Bill (Public No. 336) providing for three kinds of parcels post, two of which are to have a weight limit of eleven pounds, and one a weight limit of four ounces, at different rates, to become operative January 1st, 1913.

The present parcels weight limit of four pounds is thus extended to eleven pounds, and conforms with that of several foreign countries. Fourth class mail matter is to embrace all other matter, including farm and factory products, not now embraced in either the first, second or third class, not exceeding eleven pounds, nor larger in size than seventy-two inches in length and girth combined, and not likely to injure in form or kind the person of any postal employee or damage the mail equipment or other mail matter and not of a character perishable within a period reasonably required for transportation and delivery.

The postal rate of this class is to vary in amount according to the distance the parcel is to go. This, we believe, will be the most vexatious and annoying feature of the new plan, and contrary to the purpose of our general postal usage, that is, one rate regardless of the distance traversed. The country outside of the Philippine Islands is to be divided up into units of area thirty miles square, which forms a so-called "postal" center, and postal maps or plans are to be put up everywhere showing the location of these numerous centers. The immediate place where the sending party happens to live is called Zone No. 1, and within a radial distance from the center of this zone of 50 miles a package weighing one pound or a fraction of a pound can be sent for five cents and three cents for each excess pound or fraction of same.

Zone No. 2 includes a radial area of 150 miles from the center of Zone No. 1, with a rate of six cents for the first pound or fraction of same and four cents for each additional pound.

Zone No. 3 includes a radial area of 300 miles beyond the center area of No. 1, with a rate of seven cents for the first pound or fraction of same and five cents for each additional pound or fraction thereof.

Zone No. 4 includes a radial area of 600 miles from the center area of Zone No. 1, with a rate of eight cents for the first pound or fraction thereof and six cents for each additional pound or fraction of same.

Zone No. 5 includes a radial area of 1,000 miles from the center area of Zone No. 1, with a rate of nine cents a pound or fraction thereof and seven cents for each additional pound or fraction of the same.

Zone No. 6 includes a radial area of 1,400 miles from the center area of Zone No. 1, with a rate of ten cents for a pound or fraction thereof and nine cents for each additional pound or fraction of same.

Zone No. 7 includes a radial area of 1,800 miles from the center area of Zone No. 1 with a rate of eleven cents for the first pound or fraction thereof and ten cents for each additional pound or fraction of same.

Zone No. 8 includes all territory from the center of area of Zone No. 1 beyond the 1,800 miles of Zone No. 7 and any portion of the United States, District of Columbia, Philippine Islands, and United States Territories at rate of twelve cents a pound or fraction of a pound and twelve cents for each additional pound or fraction thereof.

An appropriation of seven hundred and fifty thousand dollars was made to defray the cost of special equipment, maps, stamps, directories, etc., and the Postmaster-General is given authority to increase or decrease the rates subject to the approval and consent of the Interstate Commerce Commission after investigations to insure sufficient revenue to adequately pay the cost of the service.

The Postmaster-General is also authorized to provide indemnification of shippers, for shipment injured or lost, by insurance or otherwise, and when desired for the collection on delivery of the postage and price of the article sent, and to fix the necessary charges.

There is provided also a rural free delivery and local parcel post for delivery on a route from one person to another or to the central post office limited to a weight of eleven pounds for a single parcel with a rate of five cents for the first pound or fraction thereof and one cent for each additional pound or fraction of same.

The third kind of parcels post is unrestricted as to territory limits, and is general in its operation, but the weight limit is four ounces, and the rate is one cent per ounce or fraction thereof. This rate is the same as the existing parcels post.

There is no doubt of the success and value of this new parcels post legislation, and it will certainly advance the interests of all manufacturers throughout the country.

The International Congresses

WE had occasion last April, at the time of Dr. Eijkman's visit to America, to comment on the movement for internationalism in science. The subject is once more brought to public attention about this time by the meeting of no less than three important international congresses in this country within a period of three or four weeks. Of these, the first in chronological order is the sixth congress of the International Association for Testing Materials. The purpose of this organization is well brought out in the words of the opening address by Dr. Howe: "The function of the testing engineer is to stand between the public and the manufacturers who supply that public, to test the fitness of those supplies, to measure accurately their degree of fitness and to reject unsparingly the unfit. He is a guardian of those who travel by land or sea and of those who live or work in buildings of important size. He is the protector of the material interests of the public, because in the last analysis all structures and all materials of which they are made are for the use and benefit of the public, individually and collectively, and are paid for directly or indirectly by that public.

"To make this work of the testing engineer more effective, to guard the lives and the interests of the public, is the object of the association's existence. It is an open court in which the public sits in judgment on the various methods of testing."

An event which calls for our very special attention is the assembling in Washington and New York of the Eighth International Congress of Applied Chemistry. Something of the scope covered by this meeting may be gathered from the fact that the advance copies of the papers to be read fill no less than twenty-four octavo volumes. Some of the most significant of these will appear in the pages of our SUPPLEMENT. Yet the most important function of such a congress is not the presentation of papers, but rather the opportunity it affords for the direct interchange of ideas between the members attending.

And, thirdly, during the last week of September there will meet in Washington the Fifteenth International Congress on Hygiene and Demography. To say that the subjects treated are of vital importance is to use in a literal sense an expression which has become weakened by its over-frequent application as a figure of speech. After all, though in the mind of the technical man industry and commerce naturally are uppermost, these things are merely means to an end—methods of ministering to our welfare—and it is true for the community as for the individual that health is of greater importance than wealth.

The month of October also brings two international congresses to our continent. The Seventh International Dry Farming Congress will be held at Lethbridge, Alberta, October 21st to 26th, 1912. In connection with it will be held the International Congress of Farm Women. A feature of the meeting will be an agricultural show, comprising exhibits of farm products grown without irrigation under a rainfall of not more than 20 inches per annum. These congresses are attracting more and more attention throughout the world. To the sixth, held last year at Colorado Springs, thirty foreign countries sent delegates. Dr. John A. Widtsoe, president of Utah Agricultural College, is president of this year's congress, which will be the first held outside the United States.

It gives us, as Americans, no small satisfaction to play host to the engineers, chemists and physicians assembled from all parts of the earth.

We see in this another sign that in the future America is to become a great center for the advancement of science, pure and applied.

Engineering

A Railway to Baguio.—The proposed rack railway to Baguio, the official mountain health resort of the Philippines, is to run from Aringay on the coast via Galinao. A Swiss railway expert has reported favorably on the undertaking and it is hoped to have the line completed and in operation in two years.

The Question of Lifeboats.—The president of the British Board of Trade has appointed a departmental committee on boats and davits to report on the most efficient method of stowing, launching and propelling ships' boats. The committee invites inventors and others to submit suggestions by October 1st, 1912.

Sun-power Engine Economy.—Tests made by Prof. R. C. Carpenter of Cornell University show that the sun-power steam engine, using steam of about one pound above atmospheric pressure and a vacuum of twenty-eight inches, required about thirty-one and six tenths pounds of steam per horse-power per hour. This engine has been fully described in the columns of this journal.

Collier "Neptune" is Rejected.—It is stated that the collier "Neptune," built for the United States Navy under contract, has been rejected on the ground that she does not come up to the government specifications. This ship is fitted with turbines which drive the propellers through the medium of a mechanical speed-reduction gear. We understand that the reduction gear has shown excellent results during the try-out of the machinery; but that the failure to get good all-round results was due to the type of turbine employed.

Canal Open in 1913.—Replying to a communication from the Secretary of the Board of Harbor Commissioners, Los Angeles, Col. Goethals states, that every effort is being made to complete the excavation and the work on the locks of the Panama canal by June 30th, 1913. He expects to see the level of Gatun Lake at eighty-five feet some time in September, 1913. If this be accomplished and the first boat be successfully put through the canal, announcement will be made that it is in condition to pass shipping. This, the Colonel says, will allow of a year's try-out before the formal opening.

Six-inch Torpedo-defense Guns.—The return to the six-inch gun as the principal arm for secondary batteries is a noticeable feature of naval development in these days. When the "Dreadnought" appeared, the secondary batteries were abandoned and dependence was placed upon three-inch and four-inch guns for protection against torpedo-boat attack. Torpedo-boat destroyers, however, have increased so rapidly in size, that a larger gun is necessary to deal with them, and most of the navies have returned to the 6-inch piece; none are using less than the 5-inch or the 4.7 inch.

An Aerial Railway on Mont Blanc.—Aerial railways, which carry their passengers in cars suspended on cables, are the latest departure in the commercialization of the Alps. One of these unlovely but convenient devices is soon to be installed on Mont Blanc. Starting from Chamonix, at an altitude of 3,000 feet, it will ascend to the Glacier des Bossons at 7,500 feet, with two intervening stations. It will have a grade of 50 to 60 degrees. The line will finally be extended to the Aiguille du Midi, at an altitude of 11,500 feet. The first section is to be completed in 1913 and the extension the following year. The road will be worked with three cables—the carrier, the tractor and a cable for the brakes. Each carriage will accomodate 24 persons.

Railways in Morocco.—The Franco-German agreement of last summer concerning Morocco included a pledge on the part of these countries to construct a railway from Tangier to Fez. In general there are no engineering difficulties in the way of railway construction in Morocco and the cost is likely to be small. At present the only railway in the country is a small narrow-gage military line now nearing completion along the Atlantic coast from Casa Blanca to Rabat. All transportation between the coast and the interior is by caravan and is suspended in bad weather, as there are no roads of any sort away from the ports. Wheeled vehicles are practically unknown outside of Tangier and Casa Blanca, and the principal rivers intersecting the caravan routes are unfordable for several months of the year.

The Barno-Kano Railway, in Nigeria, recently completed, links Kano, the most important purely native center north of the equator in Africa, with Lagos, on the coast. The amazing statement is made in a recent consular report that prior to the opening of this railway most of the foreign trade of Kano was carried on by caravans across the whole width of the Sahara desert—especially between Kano and Tunis—entailing a journey of some seven months in each direction. This trade is now all diverted through British territory to Lagos by rail, and thence by steamer to European ports—a total journey of 25 days or less. Besides its far-reaching effects on trade routes the railway is rapidly civilizing the natives, who are leaving their pestilential walled towns in favor of sanitary settlements laid out for them by the colonial authorities along the new route.

Electricity

Telephoning from Norway to Finland.—The Swedes are thinking of laying a telephone cable from Marieholm near Stockholm to Abo across the Finnish Bay. The Norwegians are very interested in this proposition as they could also communicate with Finland by telephone. It remains to be seen what the Russian authorities will say to this. The cost is estimated at one half million Finnish marks.

A 175,000 Volt Transmission Line.—On Big Creek, 275 miles from Los Angeles, a large hydro-electric plant is now being built. Current from this plant will be conducted to Los Angeles at a voltage of between 150,000 and 175,000. The gradual increase of voltage used on transmission lines in California is due to the low hygroscopic conditions of the atmosphere. It is predicted that before long voltages of 200,000 and 250,000 may be employed.

Silver-plating versus Nickel-plating.—The automobile industry says *Electricity* (London) is showing a tendency to supersede nickel-plating by silver-plating for the bright parts of motor vehicles. Nickel-plating, notwithstanding its hardness, has the disadvantage that when exposed to the weather it becomes coated with a film of oxide hard to remove. Silver has a whiter color, and is capable of a richer and finer polish. The surface does not peel or corrode, and when tarnished is far more easily polished. The labor cost of plating silver is no greater than for nickel, and as a very thin deposit is sufficient the greater cost of the metal need not correspondingly increase the total cost.

The Selenium Cell as an Aid to the Blind.—An instrument recently exhibited at the British Optical Convention enables the blind to use their ears to detect variations of light. There are a pair of high-resistance telephone receivers and a portable box containing a pair of selenium cells electrically connected to a battery and to the two receivers on a balanced Wheatstone bridge system. A clockwork interruptor gives an intermittent current which causes a rasping sound in the receivers, louder in that receiver and selenium cell circuit which is influenced by the stronger light. Thus a blind man equipped with the device in which one selenium cell faces toward his right and the other toward his left can sense the difference in light on the two sides, which may give him valuable guidance in walking.

The Edison Electric House.—Announcement was made in these columns some time since that Thomas A. Edison was fitting up a house in Llewellyn Park, New Jersey, with an independent electric lighting plant and a complete equipment of electrical apparatus. The purpose of this house is to demonstrate the advantages of electricity to the farmer who is so isolated, that he cannot obtain electric power from a central station. This house is now practically complete and will be open soon to the public. The current is generated by a small gasoline engine which drives a dynamo and the latter in turn stores the current in a battery of storage cells. The particular novelty of the system lies in the simplified means of control, so that the apparatus is rendered absolutely fool-proof and may be operated by inexperienced hands.

Russian Wireless Stations in the Arctic Sea.—Russia has for some time evinced special interest in the Arctic regions, sending out each summer expeditions to Nova Zembla and other parts of Northwestern Siberia, and taking up with renewed energy old plans of a ship connection between Europe and the Estuary of Siberian rivers. Russano, the well-known Russian traveler (in the company of Kushkine, who at the time was a member of Roald Amundsen's expedition) will set out in the spring for Arctic waters, in order, among other things, to find a navigable route to the rivers of Western Siberia. In order to improve and safeguard Siberian navigation, Russia contemplates the installation of radio-telegraphic stations on the northern coast of the Russian continent, as well as in Nova Zembla and other islands.

Bare Aluminium Wires for Coils.—The conductivity of aluminium is about 60 per cent of that of annealed copper. Accordingly, an aluminium conductor must be considerably larger in cross sectional area than a copper conductor if the two are to carry the same amount of current. Aluminium wire is always coated with a thin oxide which serves as an insulator. This insulation is enough, according to some European manufacturers, to permit of using bare aluminium wire in the coils of magnets. As the oxide film is of inappreciable thickness, a coil of fine wire thus constructed would be no bulkier, if as bulky, as a coil wound with insulated copper wire. H. F. Stratton, writing on this subject in the *Electrical World*, states that he has been unable to secure sufficient insulation when depending upon the aluminium oxide film as it naturally occurs in the commercial product. In order to increase this oxide, some European manufacturers wet the coil and then heat it. This he thinks hardly sufficient, but he has produced very successful results by passing the wire through sodium hydroxide, and then drying the coil by passing a current through it.

Science

Ciudad Porfirio Diaz exists no longer. One result of the new *régime* in Mexico of interest to geographers is the change of the name of this border town (opposite Eagle Pass, Texas) back to its earlier name, Piedras Negras.

Wireless in Siam.—A powerful radiotelegraphic station is about to be erected at Klong Toi, near Bangkok. It is expected to maintain communication with Penang, Singapore, Saigon, Hong Kong, and Manila. The vessels of the Siamese navy are also about to be equipped with wireless.

Prof. Parker and Mt. McKinley.—After an unsuccessful attempt to reach the summit of Mt. McKinley, Prof. Herschell Parker of Columbia University and Belmore H. Brown returned to Seattle on August 28th. It was found impossible to reach a height greater than 20,100 feet in the face of a blinding blizzard and with provisions nearly exhausted.

A New Telescope for Alleghany Observatory.—A 30-inch refractor valued at $150,000 was recently dedicated at the Alleghany Observatory in the presence of a distinguished company of scientists. It is said that the instrument was paid for by subscriptions collected for the last ten years. Among those who officiated at the dedication were members of the Astronomical and Astrophysical Society of America.

Coal Researches in Germany.—The new Kaiser Wilhelm science advancement institution is taking measures to found an institution at Mülheim for carrying on research upon coal and kindred subjects, with the co-operation of the large industries of this region. A large part of the expenses for the buildings will be borne by the municipality of Mülheim. It is also stated, that among recent German enterprises is the founding of an experimental therapeutic establishment at Berlin.

The Radiology Congress.—The sixth International Congress of Radiology and Electrology is to be held at Prague, from the 3rd to the 8th of October next, under the patronage of several Ministers. Prof. Stoklasa, rector of the Upper Technical School of Prague, will preside on this occasion. An exposition of apparatus of various kinds will be one of the features, and the delegates will have an opportunity to visit the Radiological Institute of Vienna and the radium laboratories of Joachimsthal.

Oldest Museum in the World.—Dr. Otto Kümmel, head of the East Asiatic Department of the Berlin Museum of Ethnology, tells of the oldest museum in the world, in the bulletin of the Société Franco-Japonaise. This museum may be found in the city of Nara, the former capital of Japan. Since its foundation, in 756, it went through all the changes of the Japanese Empire without one single addition to its collection. Dr. Otto Kümmel is one of the few Europeans who were permitted to visit this museum. It opens its doors but once a year, on a day in spring, when a special committee inspects the collection, and a new list is made out. The museum contains about 3,000 articles, which are said to be the most beautiful specimens of decorative work, which have ever been produced by human hand; such as lacquer ware, decorative furniture, enamel ware, cambric like fabric, etc. The origin of the majority of the articles is uncertain; some came from China and others from Corea, but most of them appear to be of a more exotic origin. All, however, came of a time prior to the year 756.

The Work of a French Hospital Ship.—A recent consular report describes the remarkable work of the French hospital ship "Saint François d'Assise," one of two vessels maintained by the Societe des Ceuvres de Mer to minister to the wants of fishermen of the North Atlantic. The vessel in question cruises on the Newfoundland Banks, while her sister ship plies the Iceland fishing grounds and the North Sea. The hospital ship leaves France each spring and follows the French fishermen to the Banks. It carriers a crew of 27 men, including a chaplain and a doctor, and has beds for 36 patients, besides accommodations for shipwrecked sailors and patients suffering with minor ailments. During the summer it speaks each fishing vessel on the Banks, without regard to nationality, to ascertain whether its services are needed. Sick or injured fishermen are given treatment, and when the cases are sufficiently serious are kept on board. From time to time the ship puts into St. Pierre to transfer patients to the French hospital at that place. During the year 1911 the ship steamed 12,209 marine miles, spoke 1,143 vessels, admitted 70 patients to the hospital, and gave treatment at sea in 420 other cases; besides picking up 14 shipwrecked sailors. The vessel also acts as a floating postoffice, under the authority of the French government, distributing and collecting mail on the fishing grounds. No charge is made for medical treatment or for medicines. Besides its two ships the society maintains two sailor's homes, one at St. Pierre and one at Feskrudsfjord, Iceland. It has a small subsidy from the French government, but is mainly dependent upon private subscriptions from year to year.

Grenadiers of the Air

Exploits in Bomb-dropping from Flying Machines

By Major H. Bannerman-Phillips

A grenadier was originally a soldier detailed and equipped for throwing hand grenades. He has long been obsolete. Only his name remains to recall his now historic function. It may be that the flying machine will rehabilitate him. Military men have been conducting experiments to ascertain just what is the destructive effect of explosives dropped from a height by a flying machine. In the campaign bombs have been dropped under actual war conditions. In France, Michelin offered a prize for bomb-dropping achievements, which was won by Lieutenant Riley E. Scott, an American. The following article, written by a British officer who is a recognized authority on the military uses of airships and aeroplanes, shows how much and how little may be expected of the new-fashioned grenadier of the air in the present state of our knowledge.—EDITOR.

THE first thing we have to consider in connection with the use of a flying machine or dirigible balloon for dropping projectiles is: Why we should use the machine for dropping them at all, inasmuch as a gun will send them with far more force and effect, and certainly with greater accuracy of aim.

The answer is that under certain circumstances we cannot produce the destructive or demoralizing effect we require by the aid of artillery, because we can neither see the objective of our attack nor calculate by map or otherwise its probable position with practical certainty; or because, although located by our air-scouts, it is at such a distance from our batteries that a shell will not reach it; or because our aerial destroyers must first locate the objects of attack, and having done so, must act on their own account with dropped projectiles. They would require to take such action when (A) the objective is out of reach of the artillery, (B) the moral effect of the attack (a stampede of cavalry or transport horses in their lines, for instance) can be achieved with a small expenditure of hand grenades, (C) the purpose of the attack is to effect the hasty demolition of buildings, bridges, or stores, by explosion or fire, but these latter are so situated, or so well guarded, as to be inaccessible to men landing from a flying-machine, and using explosives or other incendiary means at the ground surface, or (D) when the object of attack, say a column of troops caught on the march along a causeway or bridge, would get away into safety unless the aerial destroyer acted at once, instead of returning or sending word to the artillery.

There are roughly speaking four classes of targets or objectives against which the dropped projectiles might be used with advantage, other things being equal, and four separate types of bomb would be required for use accordingly:

1. Heavy explosive bombs.
2. Small bombs or hand grenades.
3. Incendiary projectiles.
4. Aerial projectiles.

It will be convenient, to begin with, if we take each type separately.

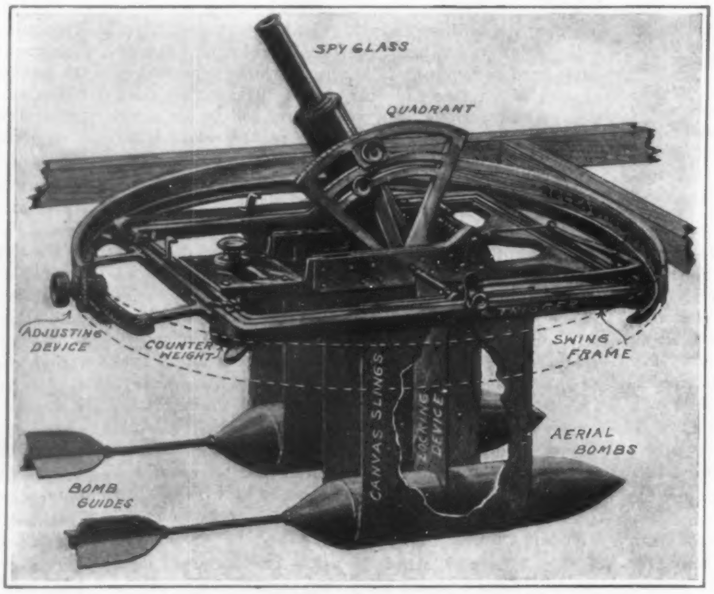
Heavy Explosive Bombs.

These would be used against such targets as dock yards, ships, railway junctions and termini, turntables, and rolling stock, bridges, postal, telegraph and wireless stations, banks, exchanges, telephone and staff offices, War Department and Admiralty buildings, range-finding bases of forts, and other nerve-centers generally. The demolition of these would tend to disorganize traffic (military and commercial) interrupt communication of orders and information, and thus paralyze the fighting forces of a nation, and bring pressure to bear on the civil authorities by cutting off supplies and starving the population.

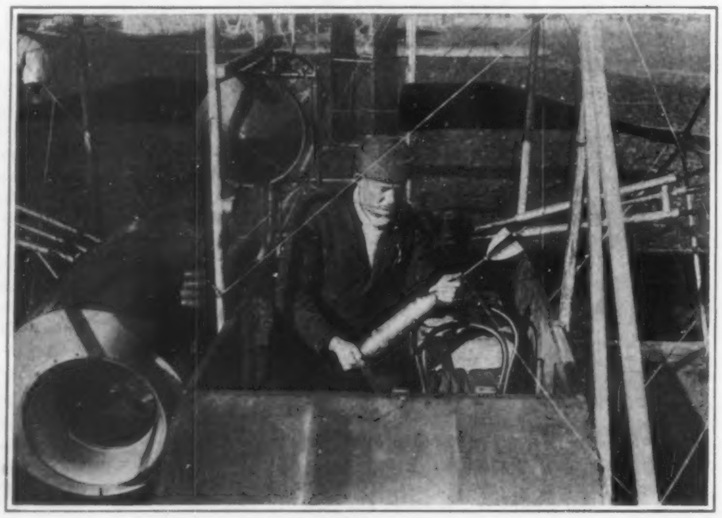
For such purposes as these the projectiles must strike the exact spot. Of the actual result of a charge of high explosive when merely *dropped*—not fired from a gun—and exploded on impact, we do not know much as yet, except that the effect, though great, is probably very local.

Hand Grenades or Small Bombs.

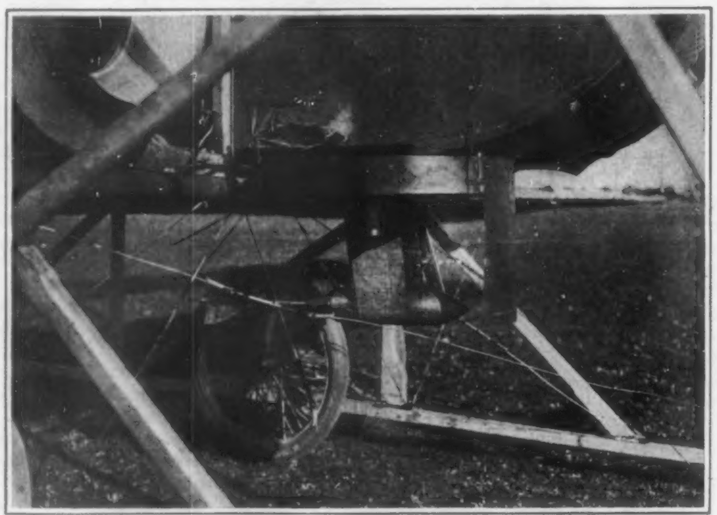
The second purpose to which dropped bombs would be put would be the attack of troops assembled in masses preparatory to extension or advance in small columns for attack; reserves kept in readiness for action under the shelter of high ground, whose position would be difficult to locate without overhead scouting, and against whom distant artillery fire could not therefore be used with certainty of effect; troops marching in columns of route along



An instrument for directing bombs from aeroplanes.



The type of aerial bomb used by Lieut. Riley E. Scott.



Lieut. Riley E. Scott's bomb-dropping device. Lieut. Scott won the Michelin prize.

defiles and hollow roads out of sight of the enemy, but visible to the airman from above and unable to extend quickly to either flank, thus forming a helpless target to overhead fire; transport and ammunition columns on the march; convoys of provisions coming up from the base of supply in the enemy's country to the troops fighting at the front, these convoys being too far off to be reached by artillery and too well guarded in front and flanks to be open to attack by mounted troops moving on *terra firma;* horse-lines, and camps of all arms, the frequent harassment of which by bombs at night would stampede the horses, disturb the well-earned rest of tired soldiers, wear them out, demoralize them, and destroy their nerve.

For these purposes hand grenades or small bombs would be sufficient, the aim need not be very precise, and a fairly large number could be carried by one flying machine.

So far the experience of the Italians in Tripoli tends to show that the moral and material effect on troops of bomb-dropping from aeroplanes by day is very small. It has even been said that in some cases the bombs did not explode, and that they were picked up and used against the Italians themselves later on. The latter, however, have not given up the idea, but have been carrying on further tests of the effect of dropped projectiles from dirigibles in Italy and off the coast. Other evidence as to the uses of the small bomb or hand grenade, as thrown from an aeroplane, is scanty and indecisive.

Incendiary Projectiles.

These would be long, hollow, metal cylinders, with solid sharp-pointed steel heads, and with a percussion fuse and a bursting charge in the head, behind the steel point, the remainder of the cylinder filled with an incendiary substance or possibly inflammable liquid, which would burn fiercely on being released by the charge. They would be so weighted and so furnished with flanges, answering to the feathers of an arrow, as to insure their falling head-on, without turning over in the air during descent, the object being to penetrate the roof or outer covering of a building, gasometer, oil-tank, or magazine, burst the charge inside and start a conflagration, or to cover a pile of stores or supplies with burning liquid. These would have to be accurately dropped or they would fail to achieve their purpose.

Aerial Projectiles.

The fourth class of target would be an enemy's aircraft, aeroplane or dirigible, traveling in all probability very rapidly in mid-air, and changing its altitude and direction from time to time in order to baffle the attacker, who to drop his projectile must rise above the object aimed at. There are, of course, projectiles which can be made to overcome the force of gravity and travel horizontally toward the target by their own powers, such as the "aerial torpedo" invented by the Swedish officer, Col. Unge, but for the present we are not dealing with any other than *dropped* projectiles. To damage or destroy a hostile aircraft by this means the airman could use an explosive bomb containing either an incendiary material or fluid, with time and percussion fuse, so as to burst after a given number of seconds, or on striking the target. The percussion fuse would have to be very sensitive, and the intention in this case would be to damage by shock of explosion and fire in the case of an aeroplane, or by explosion of the gas in the envelope of a dirigible.

The Grappling Iron.

Another class of projectile suited for use against either aeroplane or dirigible, though it can hardly be considered a

"bomb," is the javelin or grappling-iron, armed with hooks and blades for tearing and cutting the frame-work, wires, and covering material of an aeroplane, or ripping the envelope of a dirigible and releasing the gas. Dr. Barton, an English expert, has patented a bomb for aerial purposes, which is intended to combine the attributes of the explosive projectile with the ripping and tearing missile. It is of fish-like or stream-line form, with bluntly pointed head, largest diameter at the fore-end, and tapering away to a slender tail which is fitted with helical blades to impart a rotary movement, when dropped head down. The tips of the blades terminate in hooks or cutting-edges for tearing the fabrics of a balloon, dirigible or aeroplane. The bomb may be dropped or projected from a tube mounted on gimbals, and fitted with guides or gages to indicate and influence the angle of descent. A flat vane, like that of a weather-cock, may further be attached to the tail of the projectile by means of a swivel-joint, so that the bomb may rotate without rotating the vane which is normally in the same place as the longitudinal axis of the bomb, that is to say, when the bomb is allowed to fall vertically the vane is vertical and under ordinary circumstances, does not affect the direction of its flight to earth. On the other hand, this vane, at a pre-determined time, by the action of a spring released by clock-work, or a time-fuse, which burns a retaining cord, may be caused to assume a position at an angle with the long axis of the projectile, and acting as a rudder will deflect it from its initial direction more or less horizontally.

The walls of the bomb are perforated and into the holes are inserted peculiarly shaped bullets, which release two or more knife edges, when they are projected from the bomb either by one or more successive explosions internally or by centrifugal force. The bullets are assumed to fly out in all directions and, acting like shrapnel, materially increase the destructive area of the bomb. Further, an explosive may be used to burst the whole bomb and break it up into a number of ripping-and-tearing fragments of metal at any pre-determined time.

Having described the classification of objectives, which we are likely to attack by bomb-dropping or missiles from aircraft, it is as well to state that in all these cases it is understood that before commencing operations the attacker must be sure that his projectiles, if they miss the target, at least will not be dangerous to his own side. The summary of reasons for using the dropped projectile in preference to artillery, shows that usually these operations would take place over the heads of the enemy's troops or in an enemy's country, but in combats in mid-air between aircraft of any kind the rapidly changing positions of the latter might easily bring them both into the region immediately above our own troops or entrenchments, and we must be prepared to cease fire until the scene of conflict changes to a more suitable air-space.

So far, we have dealt with the dropping of projectiles in connection with the objects to be attained by the process and the kind of bomb or missile to be thrown.

Hitting the Target.

We must now consider the means of securing accuracy in hitting the mark aimed at, and this is by no means so simple a matter as it would seem at first sight, or as it has frequently been represented in sensational literature.

First of all, we have to bear in mind, that however bold, and even reckless of their own lives, the occupants of an aerial machine may be in the interests of their own country and their own forces, they are hardly likely to approach the enemy by daylight unobserved, and an aeroplane is of little use—up to the present—by night. It follows that if they are to achieve their object before being themselves destroyed by artillery fire from below, they must keep at such a height as will give them the best chance of immunity, in spite of the target they offer, while still able to see clearly what they themselves are aiming at. If the enemy also have aircraft, they have to keep a look out for these also, and though the enemy's gunners may possibly not fire for fear of injuring their own airmen, or their own troops below, by the spent shells and shrapnel, the would-be bomb-droppers cannot reckon on this, and must be prepared to become a target themselves at any moment, a friendly cloud being their only possible cover.

Now it has been proved by actual experience, that bullets from the enemy's rifles struck the aeroplanes of the Italian aviator in Tripoli at a height of 1,800 feet, and 3,000 feet as been suggested as a altitude, which it would be advisable for an airman to remain at, in presence of the enemy, in order to be reasonably immune from damage. This is not to say that he could not be reached by shrapnel or other projectiles, since there are guns which can throw their shell 10,000 feet and more, but taking into consideration the height of 3,000 feet combined with the pace, say 35 to 60 miles per hour, of an aeroplane, and its constant changes of altitude, it would be an exceedingly difficult mark to hit, and rapidly to judge distance on, in order to calculate for, and adjust the fuse, to burst the shell at the right place.

We must realize accordingly, that the bomb dropped from an aeroplane or dirigible has presumably to travel some 3,000 feet, say 1,000 yards, before reaching the object aimed at; that the aircraft is going at a considerable speed, and that the projectile consequently does not drop vertically on to the target, but describes a curve, the shape of which depends on the speed of the machine at the moment the bomb leaves it; that the projectile must therefore be released some time before the machine is vertically above the target, and that bomb-dropping, instead of being a simple matter, requires skill and considerable practice.

Besides this, some special form of sighting and dropping apparatus is advisable, and the bomb-thrower must give his whole attention to his work. If he is to achieve accuracy and economize ammunition he cannot act as pilot in addition. Even so he will find that, except in such cases as strewing hand grenades broadcast over a fairly large area, such as a camp, it is exceedingly difficulty to hit the objective and get satisfactory results. So thoroughly is this difficulty realized by those who have gone into the matter by the light of the little actual experience available, that it is considered, that in order to do any serious damage at the ground level from a reasonable height, there must be a number of flying machines in action and a plentiful supply of bombs.

The Difficulty of Aiming.

Viewed from this stand point the typical 'aerial destroyer" of fiction, setting out alone, but balefully efficient, to wreck ships and forts, strew death broadcast among troops, and decimate the population of a hostile township, and then bringing the recalcitrant enemy to his knees by the threat of continued destruction on the same lines, fades into the limbo of the extravagant and the impossible, but very serious possibilities still remain to be reckoned with, and it is worth our while to go into the question of sighting for the drop of a bomb and the means of release at the right moment.

The ideal method of attack would be to approach the vicinity of the target at high speed and slow down when within range, then hover immediately over it, sight the object through a telescope, drop one or any required number of projectiles through a special tube in connection with the sighting apparatus—and return to safety as quickly as possible. Such a plan as this might be feasible at night, in calm weather, with a dirigible, which can stop its engines and float noiselessly.

It is even remotely possible that it may be achieved with a heavier-than-air machine at some future time; for if we may

(Continued on page 229.)

The bomb-dropping apparatus employed by Lieut. Bousquet, who won second place in the Michelin contest.

Lieut. Bousquet seated in his aeroplane in which he competed in the Michelin bomb-dropping contest.

Lieut. Maillefer ready to start on a bomb-dropping flight. The bombs are contained in a trough.

The Flying Boat and Its Possibilities

How Safe Flying Over Water Has Been Attained and What It Means

By Carl Dienstbach

THE latest flying machine is an aeroplane that floats and runs on water, and that, at the will of the pilot, rises into the air and comes down to water again. This invention has opened new possibilities in flying because the hydro-aeroplane can stop and end its flight wherever a motorboat can be operated, and because it can be used as easily and as extensively as a motorboat. An aeroplane derives no support from the air unless it is quickly driven ahead. It must always start and land dead against the wind, and it needs, therefore, a clear level field of sufficient extent to begin or end its flight. Moreover, it can start and land only on a specially selected flying field. The great skill required to keep the aeroplane continuously in the air makes prolonged flying possible only for very experienced pilots. Even then a landing can be safely made only on a flying field. Pilots who fly at great altitudes across country always feel worried lest motor trouble should compel a landing. Even when gliding down from a height a suitable clear level field cannot always be reached. What appears as an inviting meadow from a distance may prove to be a swamp. Against his will the aviator may be compelled to alight at great risk. In great cross-country aeroplane races machines are often broken and passengers injured when they are thus forced to come down on unsuitable ground. The hydro-aeroplane that can alight on the water can come down everywhere and at any moment with perfect safety.

Early Attempts at Flying Over Water.

There are, in fact, so many advantages to be derived by starting and landing on water, that one wonders why the aeroplane was not originally a hydro-aeroplane. The first experimenters did indeed design their machine to start and alight on the water. Octave Chanute, who was the first engineer that had a clear conception of the difficulties of flying, urged all experimenters to try their apparatus over water, because "The worst that could happen to them there would be a ducking." Prof. Langley followed the same theory. Mr. Manley, who was on Langley's machine when twice it fell into the water, after being broken by the mechanical launching apparatus, undoubtedly owes his life to Langley's foresight. Maxim ran his purely experimental machine, with which he did not attempt any free flying, on a railroad track. Hargrave, Kress and Blériot made their early free flights with motor-driven aeroplanes provided with floats and started from water. The only exceptions were Lilienthal and Herring, neither of whom built aeroplanes in the modern sense, but rather wings which were so light that the aviator could carry them on his body. Archdeacon in Paris also mounted his aeroplane on floats and started it from the water, but his was only a gliding machine without motor or propeller, flown like a kite by towing it with a fast racing motorboat. Apart from all other considerations, the most elementary engineering principles would lead an experimenter to design an aeroplane as a hydro-aeroplane. A machine which has to move ahead before it can be supported in the air is, above all things, a vehicle with horizontal sails.

It was, in fact, a very definite necessity which finally caused Hargrave, Kress and Blériot to abandon the floating planes and to give us the swift aeroplane starting from a monorail with the aid of a catapult and landing on skids on soft ground. The necessity was most clearly illustrated when Glen H. Curtiss, the inventor of the first successful hydro-aeroplane, made his first experiments with an aeroplane mounted on water floats. Curtiss had every inducement to experiment with hydro-aeroplanes, and it is no doubt due to these that the world owes the invention of his useful type. The flying grounds at Hammondsport, where the Curtiss aeroplanes are built and tested, are small, but Hammondsport is situated on the shores of Lake Keuka, which would have offered an ideal flying field if it had been possible to start the machine from its surface. Consequently, in the fall of 1908, "June Bug," the first publicly demonstrated successful American aeroplane, was taken from its wheeled chassis and mounted on two canoe-like floats that resembled an ordinary catamaran. Although this was a machine that had flown well over land and that was far better equipped to get into the air than either the Hargrave, the Kress or the Blériot machine, it could be made to run quite fast on the water, but never fast enough to rise into the air. The reason is not far to seek. A speed that may be very fast for a water craft may be too low to start an aeroplane and support it in the air.

How a Flying Boat Should be Built.

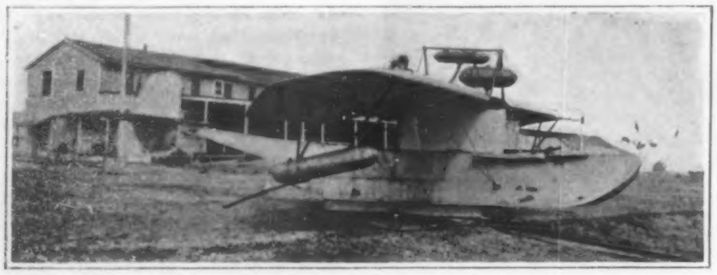
It is very easy to design a hydro-aeroplane on wrong principles. There are two ascending scales of effort that may be made to meet—then the hydro-aeroplane is successful—or which may not happen to meet each other—and then it is a failure, however well it may fly from the ground. The first scale is the constantly increasing head resistance of the floats in the water, which increases very rapidly with speed, and the second scale is the constantly increasing support of the planes in the air which also increases with the speed, but very much more slowly than the water resistance. This is due to the fact that what is fast in the water may be slow in the air, and that water resistance and air support both increase with the square of the speed. It is evident that the motor may exert its utmost power to drive a machine through the water with a speed that seems very fast, but that falls a trifle short of sufficiently supporting planes whose lifting power increases with the small squares 4, 9, 16, 25, 36, while the water resistance increases with the large squares such as 64, 81, 100, in spite of the fact that any appreciable lift would take the float partly out of the water and decrease the water resistance in turn. The result is that even a slight reduction of the resistance in water would enable a hydro-aeroplane to fly, which at a speed only a little lower, has practically no lift whatever. Obviously either a more powerful motor must be employed or the water resistance of the floats must be reduced. The four-cylinder motor that drove the first Curtiss aeroplane overland probably could not lift the present Curtiss hydro-aeroplane out of the water.

But the real solution of the problem—the real invention—lay in the design of the floats. This problem had already been partly solved in the hull of the fast racing motor-boats. Naturally, they were taken as models. A new principle was introduced, and that was the principle of the hydroplane, or gliding boat.

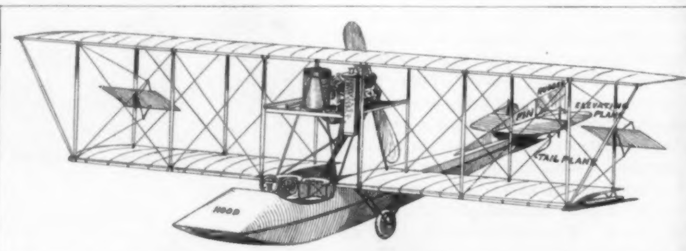
The Hydroplane Principle Offers a Solution.

The floats themselves had to be made to exert a lifting effort; the speed was increased to raise the floats out of the water by their own action. Thus the wings were enabled to exert their own lifting effect. In short, the hydroplane filled the gap between the two scales of effort mentioned. The moment Curtiss had found the proper shape for his flat-bottomed, rectangular-outlined float, the first practical hydro-aeroplane rose from the water.

Curtiss, indeed, was not the first one to make a hydro-aeroplane rise at all. Fabre in France had anticipated him in that, but Curtiss gave us the first comparatively perfect machine. With the practical sense he has repeatedly shown, he recognized that one float has less water resistance for the same floating power than two floats, and that one float also makes the lateral balance of the floating machine more independent from the disturbance of the water level by waves than catamaran floats. He prevents his machine from capsizing by small auxiliary floats beneath the wings. He also has so shaped the floats that if by any reason or mistake of the pilot the machine should ever come down at a steep angle, the upper surface of

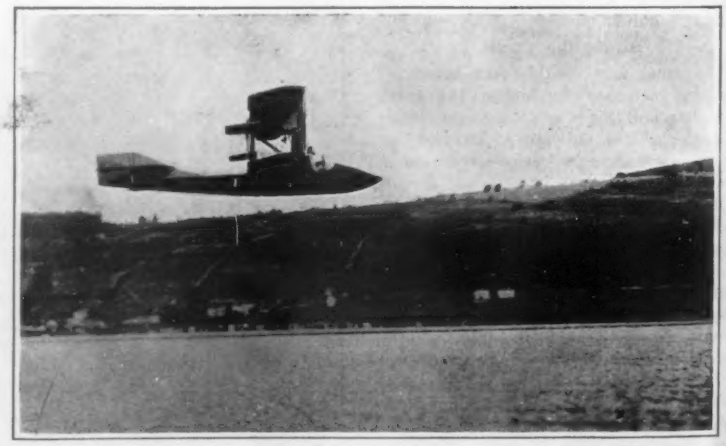


G. C. Loening's monoplane boat. This is the first monoplane boat constructed in this country. It was tested on July 25th in a voyage of 52 miles, during which occasional short flights were made.



The Curtiss boat is driven by an 80 horse-power motor. It is 26 feet long, 3 feet wide, and has a depth of hull about equal to the width. The planes are 5½ feet deep and 30 feet wide.

Lieut. Conneau's hydro-aeroplane in which he made some remarkable flights in France before he came to grief.



The Curtiss hydro-aeroplane in flight. The operator and passengers sit well down in the hull and are protected from the spray by a collapsible waterproof hood.

the float will not strike the water and thus overturn the machine by the tremendous resistance it would meet at its great speed.

There are at present very many types of hydro-aeroplanes. After the floats had been changed to hydroplanes nearly every type of aeroplane was transformed into a hydro-aeroplane simply by mounting it catamaran-like on two hydroplane floats that took the place of the ordinary wheeled running gear. But all these machines experience trouble if the water is rough. The single float type, on the other hand, leaps from wave to wave and starts at a light swell even in troubled water. Attempts are being made to make the hydro-aeroplane still more like a legitimate water craft by transforming it into a boat with wings. If that is done without impairing its flying qualities, it will certainly be for the better.

Even the best fliers have recently met with so many accidents while flying overland at great altitudes that ordinary men are afraid to take chances. Besides, there was always the necessity of starting from a distant flying field. As explained in the beginning, the hydro-aeroplane is not restricted to any flying field. Its shed may be erected on the grounds of any yacht club or preferably on a float anchored in the river. The shed may be floorless and the machine float like a boat on the water inside, sheltered from the wind. With its great speed and perfect obedience to rudders in the water, the hydro-aeroplane may run a long distance to a spot where the water is clear of traffic. It is not too big for a river; whereas the regular aeroplane is much too big for an ordinary road. It may run wherever a yacht runs, and withal the pilot has the pleasure of flying and of moving at high speed.

High Flying Not Essential.

Most important of all, the hydro-aeroplane, unlike the land machine, need not fly very high. It is only necessary to remember how even land birds skim the water. Flying is so much easier over water than over land because the conditions of the air over water are so totally different. Over water there is no dust, no obstacles to break up the air currents, no descending currents or air holes, and no ascending currents. The whole surface of the water is uniform in temperature. It does not heat the air and send it up in an invisible, dangerous whirlpool. In short, it may be said that near the water's surface the air is nearly as perfect for flying as over the land at great altitudes.

The whole surface of the water is one immense flying field, so that the hydro-aeroplane's pilot may come down and continue at a fast clip on the water and go up again whenever he pleases. Hence, even more or less inexperienced fliers, who have only learned to jump a few feet from the ground, may still take long excursions in a hydro-aeroplane. Too much, however, must not be expected from present hydro-aeroplanes. Obviously the floats of a hydro-aeroplane must be more like coasters than even the skids of an aeroplane. Skids are used only for a short run, but floats are required for long excursions.

Everybody knows that there is much wind over water. The planes must be pointed differently into the wind while running on the water than the floats are pointed in the water. This is something for designers to consider. The planes should be as adjustable as the sails of a yacht. But if a hydro-aeroplane is designed always to head automatically into the relative wind, like a weathervane, it will have no more to fear from squalls and storms than a motor-boat. It should also be built so strong that it will not be broken by a fall into the water from a moderate altitude, and its weight should be so distributed that in the water it will always regain an even keel and right itself again, no matter in what position it drops. If that is attained and the construction is strong, the hydro-aeroplane will be as safe as a dirigible (which it resembles because of its power of flotation). It may be upset, but it will always right itself again automatically upon touching the water and get into position to continue its flight.

The Coming French Maneuvers

THE coming maneuvers of the French army will see the application of the new ideas regarding aeroplanes and airships which were decided upon by the War Department. Each of the opponents in the maneuvers will be provided with an airship as well as a certain number of aeroplanes, and two airships will be held in reserve. To each party are allotted four fleets of aeroplanes or units of six aeroplanes each, making 24 in all, or 48 for the entire army. Each fleet is commanded by its officer. Aside from this there will be a number of aeroplanes put in service for artillery observations. On the whole, this year's programme is much more extensive than last year's, and the aeroplanes will be better organized as to supplies and repairs. For the first time there will be made an experiment in the use of aeroplanes for searching for wounded upon the battlefield, and Dr. Reymond, who is among the prominent military pilots, is in charge of this work.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Nitrocellulose and Wood

To the Editor of the SCIENTIFIC AMERICAN:

Under date of August 17th, 1912, you published an article that contained the statement that nitrocellulose solutions used as a varnish did not adhere well to wood. I have had ten years' experience in the use of materials used as varnish, and I know of nothing in this line that will adhere better.

About twenty years ago Mr. Goldsmith of the American Lead Pencil Company patented the idea of using nitrocellulose solution for finishing pencils. The idea was of great value, and Mr. Goldsmith successfully defended his patent, which is now expired.

Many hundreds of barrels of nitrocellulose solutions are annually manufactured and sold for use on wood by the concern which I represent. I am not seeking any free advertising, and my statements are merely in the interests of accurate information. There are many users of nitrocellulose solutions who well know that the statement that it will not adhere well to wood is inaccurate. FRANK P. DAVIS.

New York city.

Futility of Dredging the Mississippi River

Editor of the SCIENTIFIC AMERICAN:

In your issue July 13th, p. 23, reference is made to the prospective use of the Panama canal plant upon the levee system of the Mississippi River. "This would at once serve the double purpose of increasing the *flood capacity* of the river," etc.

Presuming that the flood capacity increase means the deepening of the river-bed and not the elevating of the height of the crown of the levees, I would state that in St. Paul, several years ago, a sand embankment was made from sand dredged from the river-bed of the Mississippi. How many hundreds of thousands of cubic yards were removed from the river-bed and piled upon the banks I do not know; but if I am correctly informed, the river bottom where the dredge sucked out the sand, like the muchly cursed Raven in Ingoldsby, "was not one penny the worse," as far as increasing its depth was concerned, and yet enough sand certainly was taken out to float the Mauretania in the displacement, and some other ships in addition.

Prof. Pinchot estimated that each year 400,000,000 tons of surface abrasion, call it silt, finds its way into the river, which, as it drifts along, helps to fill up a pot hole or two here and there.

Mark Twain, who knew the river quite well, and as a pilot had need to, remarked that dredging the Mississippi and keeping it dredged would be accomplished coeval with the time when Hades froze over. An indefinite proposition as to the fixedness of time and eloquently expressive of a negative result.

Point Loma, Cal. CHARLES CRISTADORO.

A Defect in Our Patent System

To the Editor of the SCIENTIFIC AMERICAN:

What seems to some a defect in the patent system appears to have been overlooked by Congressman Oldfield and other recent investigators. I say defect in the patent system, because while the defect appears in the procedure before the Patent Office, no remedy is suggested except through the change in the law itself.

I refer to the practice, that permits the issue of patent with claims dominating a prior patent without the prior patentee's having been afforded an opportunity of contesting the question of priority with the later patentee. This condition of affairs is found, when A issues a patent on limited claims, and B in an application pending concurrently with A's or filed subsequently to the issue of A's patent secures the issue of his patent with claims broader than A's. Suppose for instance, A shows one specific form of a generic invention and issues his patent on claims specific to his form. B then, after the issue of A's patent files his application for patent for a different specific form of the same generic invention and issues his patent subsequently to A's on broad claims for the generic invention by making oath to the completion of his invention prior to the filing date of A's application. B may delay the issue of his patent so long as to defeat A's right to a reissue or A may in other ways fail of reissue rights. How shall it be remedied? Possibly by providing special reissue privilege to A under the circumstances and by requiring, on the allowance of broad claims to B, that the patentee A, shall be notified and given the opportunity of filing reissue application containing the broad claims. Such notice might secure one of two results. In the first place, the patentee might assert a claim to the invention and file proper papers toward the enforcement of his claim. On the other hand, he might be in possession of some facts, which would show that the invention covered in the claims suggested and allowed to the subsequent applicant were not patentable, and in this way, the action might not only result in preventing an injury to a patentee, but, might also be of service to the public in preventing the issue of a patent for claims which were not, in fact, patentable.

Possibly some better remedy can be suggested. I do not feel capable of suggesting the full remedy, but only call attention to something that seems to demand remedial action. AN INTERESTED READER.

[In the case referred to, it appears that each inventor got what he claimed. Presumably each claimed what he invented, and so got all that he deserved.—EDITOR.]

Some Obstacles in the Way of Converting the Sahara Desert into a Sea

To the Editor of the SCIENTIFIC AMERICAN:

The idea of flooding 250,000 square miles of Sahara through a canal from the Mediterranean has some interesting features. You say that this area has 6,969,600,000,000 square feet. There are 525,600 minutes in a year. To put one foot of water over this surface in a year would require the canal to carry a little over 13,200,000 cubic feet of water per minute. As the evaporation in Sahara would probably not be less than five feet per annum the canal would have to carry 66,000,000 feet per minute to provide for this evaporation. A canal having a body of water 100 feet wide and 25 feet deep would provide for this if the flow was five miles per hour, but five miles per hour for an average would make a very swift stream in the center. Hence, the canal would have to be about three times as wide to prevent the banks from being washed away.

So far we have only provided for evaporation. To fill the 250,000 square miles to a depth of 200 feet in forty years would require a canal of twice the size or about 600 feet wide. If it were to be filled in less time it would be necessary to have the canal still larger. Of course the whole 250,000 square miles would not be covered at once, and consequently the evaporation would not be so great for several years, but the sands of Sahara are probably pretty thirsty and would probably absorb a good deal of water before any surface of consequence could be had.

But there is another view of the matter that is interesting. If the surface of Sahara is 200 feet below the ocean, then the lower parts of it might be filled to the depth of 100 feet and the remaining 100 feet be used as a fall to obtain water power. Assuming that 100,000 square miles would be covered in this way the canal would be required to carry 5,280,000 cubic feet of water per minute to balance evaporation. This quantity of water falling 100 feet would give approximately 1,000,000 horse-power. Assuming 50 per cent efficiency, 500,000 horse-power might be useful when sent over wires at about 100,000 volts. An inland sea of 100,000 square miles would probably be sufficient for ordinary purposes. But is the Sahara Desert as low as this, and is it possible to get any such thing?

Chicago, Ill. C. L. REDFIELD.

A Mathematical Card Trick

To the Editor of SCIENTIFIC AMERICAN:

The following is an old and interesting mathematical card trick, and perhaps some of your readers can explain why it works out.

From a pack of playing cards take out the jacks, queens and kings, leaving thus 40 cards. Now lay them face upward in the following order:

(Diamonds)	1	2	3	4	5	6	7	8	9	10
(Hearts)	10	1	2	3	4	5	6	7	8	9
(Spades)	9	10	1	2	3	4	5	6	7	8
(Clubs)	8	9	10	1	2	3	4	5	6	7

Next pick up the cards, one at a time, and lay them in a pile face downward, beginning from the right upper corner (10 of diamonds) downward to the 7 of clubs; follow with the next line to the left (9 of diamonds, 8 of hearts, etc.) and so on to the last card at the left lower corner (8 of clubs). Now spread the cards again, face downward, in 4 rows of 10 cards each, from left to right beginning with the card at the top of the pack (8 of clubs). The cards are now ready for performing the trick which consists in guessing the exact location of any of the cards, at the request of the spectators.

To work it out multiply the number representing the value of the card called for by 4 and add 3 for hearts, 6 for spades and 9 for clubs (nothing for diamonds). For instance, suppose the 2 of diamonds is called; 2×4 equal 8. The eighth card (counting from left to right, first upper row) is the 2 of diamonds. The 6 of hearts would be found thus: 6×4 equal 24, plus 3 equal 27; the 27th card, i. e., the 7th card in the third row should be the 6 of hearts, and so on. When the product plus the number added exceeds 40, count the excess from the first upper row again; for instance, the 9 of clubs should be 9×4 equal 36, plus 9 equal 45 (excess 5) the 5th card in the first row is the right card.

Mayaguez, Porto Rico. WILLIAM FALBE.

The Gnome Rotary Engine

The Airman's Chief Reliance

By Earle L. Ovington, Consulting Engineer, Licensed Aviator

Wonderful records for speed and endurance, for high-flying and passenger-carrying have been made. They testify mutely to the efficient motors upon which the record-breakers relied. Almost all of the more remarkable feats of the aeroplane have been achieved with the rotary motor—a type originally invented in this country but carried to perfection in France. In this article, written by a man who is not merely a noted pilot but also an engineer trained at the Massachusetts Institute of Technology, we are told what the Gnome engine means to the man in the air and to what its astonishing success is due.—EDITOR.

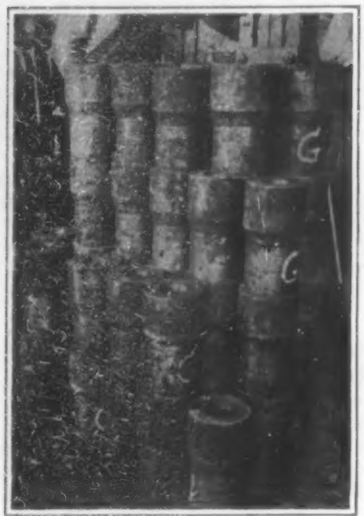


Fig. 1.—The cylinder blanks as they come from the drop-forging hammers.

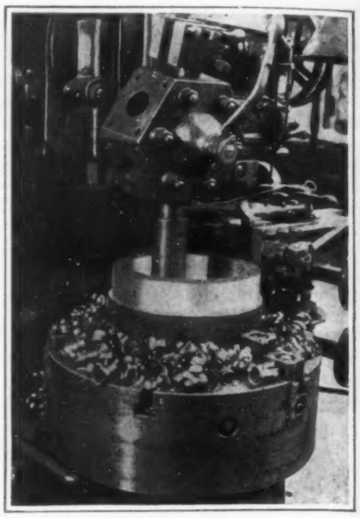


Fig. 2.—First process of working the heavy cylinder blank—roughing out the bore.

ONE of the most interesting afternoons, if not the most interesting, that I spent in Paris was when I went through the well-equipped factory where the wonderful rotary Gnome engine is made. Monsieur Seguin himself, the designer of the motor, acted as my guide so you may be sure that I saw about everything there was to be seen.

The spectacularly rapid development of the aeroplane is due, far more than even those in close touch with aeronautic affairs seem to appreciate, not so much to the improvement of the aeroplane itself as to the perfection of the motive power.

In July, 1909, Blériot flew the English Channel, and his feat was heralded as almost miraculous. And, indeed, it was, as those can appreciate who are acquainted with the motor he employed for his epoch-making flight—a three-cylinder affair, which developed not over twenty-five horse-power at the most. I learned to fly at Pau, France, with the same type of motor and was forced to try three before I could get one which would remain cool long enough to carry me the short distance required in the flights for a pilot's license. And when I landed, the temperature of my engine was nearer that of an overheated stove than that of an efficient internal combustion motor. The Blériot monoplane of to-day is practically the same as the one used in that memorable first Channel flight, and yet is capable of sustained operation across country as well as ideal for high-altitude work. In fact, the world's altitude record, made by Garros, was made with this machine. In the Boston *Globe's* Tri-state aeroplane race, I won the $10,000 prize by flying one hundred and eighty-six miles in three hours and six minutes, and when I landed my motor was in nearly as good condition as when I started.

Why this difference between the monoplane with which Blériot was just able to fly the Channel, and the modern efficient plane of to-day? One word tells the story—the motor. To be sure, aviators are more daring in 1912 than they were in 1909, but primarily, this is due to the fact that they know their mechanical birds are more dependable than formerly; and this dependability is largely due to the improvement in the motive power.

If I were asked to give my opinion of the Gnome motor in as few words as possible, I should say that it was theoretically one of the worst designed motors imaginable, and practically the most reliable aeroplane engine I know of. I should have to add as a qualification that I assume it receives the constant attention of expert mechanics. As I had two seventy horse-power, seven-cylinder Gnomes with my Blériot monoplane, and probably flew more miles last season with a Gnome motor than any other aviator in America, I speak from experience. If an expert engineer on gasoline engines were asked to examine a Gnome motor, one having no previous knowledge whatever of the mechanism, he would unquestionably pronounce it an impractical, though a highly ingenious construction. In fact, when the first Gnome shot meteorically into the limelight, this was the universal opinion in engineering circles.

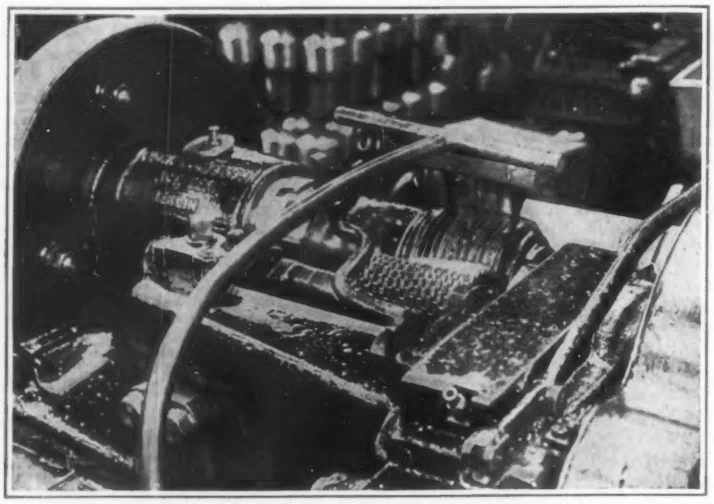


Fig. 3.—Flanging a cylinder in seven and one-half minutes; the previous tool took nearly three hours.

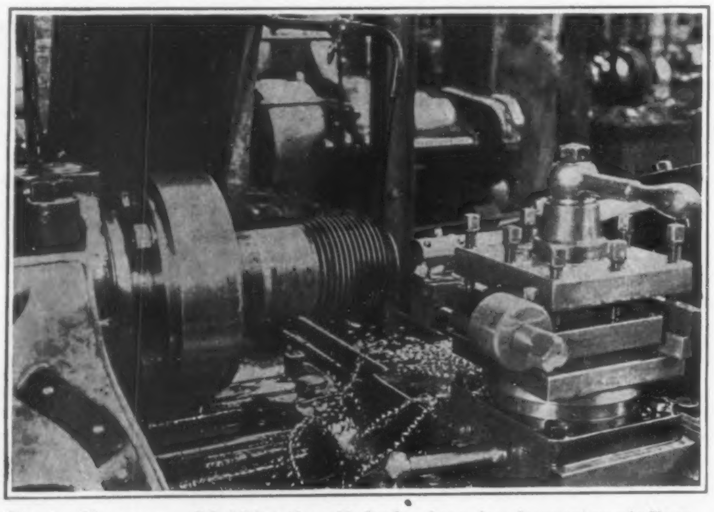


Fig. 4.—The process of finishing the cylinder head requires frequent regrindings.

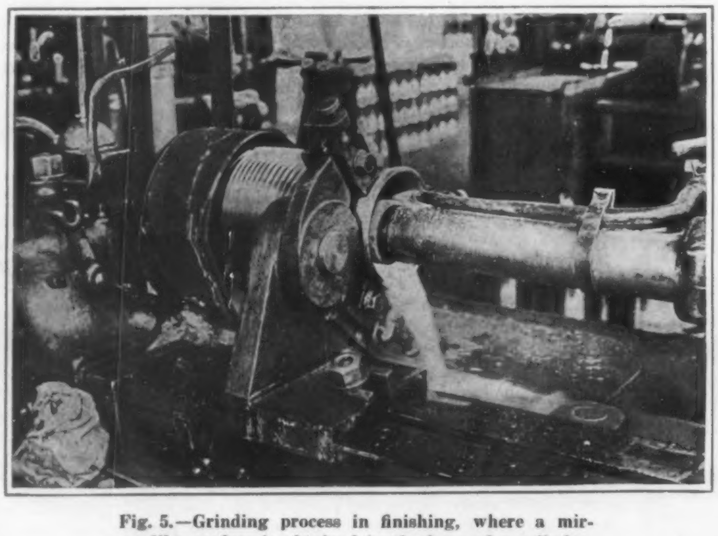


Fig. 5.—Grinding process in finishing, where a mirror-like surface is obtained in the bore of a cylinder.

You can hold a Gnome piston in one hand and break a piece from it with the thumb and finger of the other, the walls are so fragile. The valves are so thin and so large that you never cease to wonder why they are not warped out of shape before they have been in service three minutes. Literally, no piston rings are used, the "obturateurs" which serve the purpose being simply rings of thin sheet bronze, one to each cylinder. Compression in a Gnome is noticeable by its absence and, "of course," says the engineer upon first examining the engine, "the spark plugs would be rendered useless as soon as the motor attained its speed." This is what might be expected with the plugs situated in the cylinder heads of a revolving motor where a gallon of oil goes past them every hour of operation, but there is seldom plug trouble. Yet, withal, the Gnome motor is, in my opinion, in a class by itself where the greatest power for the least weight, together with reliability, is desired.

The Gnome is a very expensive motor to buy and to keep up. My seventy horse-power engines cost me $4,000 each, and I paid three French mechanics fancy salaries to act as trained nurses for the delicate mechanisms. *But I had the highest power motors for their weight, and that is what is wanted for exhibition work.* At the Chicago meet, I won the price of a motor in a couple of days' flying. Yes, I will acknowledge the Gnome is expensive to buy, expensive in upkeep and delicate in construction, but for speed and reliability, I have not found its equal.

"How can a delicate motor be reliable?" you say, and I do not blame you for asking, for such a statement seems paradoxical. Nevertheless, it is a fact. Let me explain. Usually every fifteen hours of running, and at most every twenty, my mechanics went through the interesting process of separating every single component part of my motor one from the other. The valves were reground and retimed, new valve springs were inserted, the tappet rods were adjusted, and the whole motor was given a rigid inspection. The Gnome, in common with most rotary motors, uses castor oil as a lubricant, hence at each cleaning great quantities of carbon were removed. I claim that any engine requiring such attention may rightly be termed "delicate." How far would you get in an automobile if you had to take the entire engine to pieces and readjust practically every working part of the whole motor every fifteen or twenty hours of service?

But—and this is the important part to the aviator who depends upon speed and

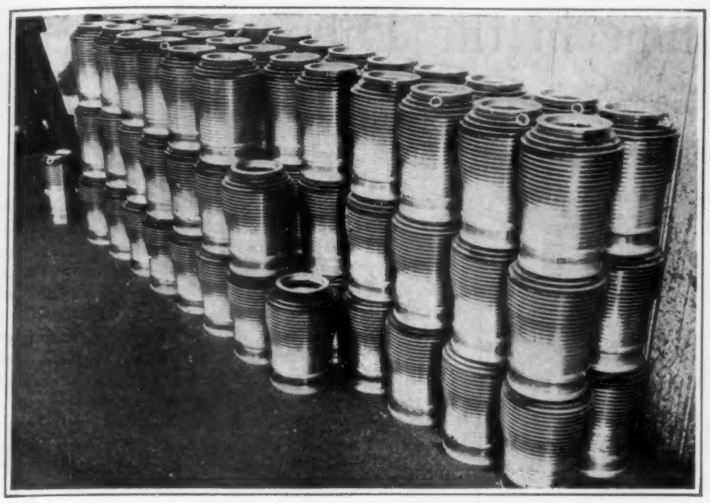


Fig. 7.—A pile of completed cylinders cut from solid bars of steel at the Gnome factory.

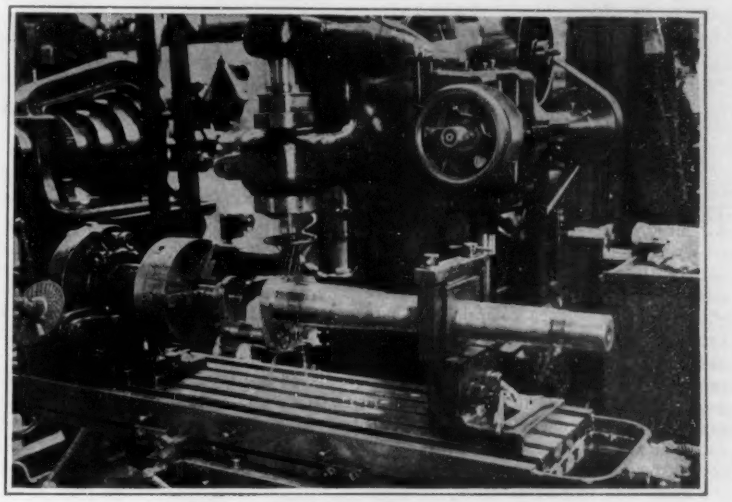


Fig. 8.—View picturing the finishing of the hollow crankshaft of a Gnome motor.

exhibition work for his remuneration—my Gnome motors never stopped while I was in the air, unless I purposely cut off the ignition, and—another consideration of equal importance—I had great power combined with light weight, which usually brought me in either the winner, or at least second man, in a race where perhaps the prize was $1,000 for a fifteen-minute flight. I made one hundred and seven flights in my Blériot and never broke a single stick in the machine, and I attribute my success largely to the fact that my motor never failed me in the air. I had several bad smashes, but in every case without exception these smashes were due to motor trouble, and they occurred when I flew a machine other than my faithful Blériot "Dragon Fly," which was given such careful scrutiny by my expert French mechanics.

The Gnome factory, situated on the outskirts of Paris, is not a large one, but it is unusually well-equipped and up-to-the-minute in operation. The very latest type of machinery is employed throughout, and wherever possible it is automatic to the last degree. This employment of automatic machinery of the latest pattern is not as common in France as in this country, and even in some European countries, for the French are proud of their handwork. Incidentally, the greater part of the automatic equipment is made in America—the home of the automatic machine tools. If we judge the character of a factory by the weight of its output, then we would have to acknowledge that the Gnome establishment turns out steel shavings, with motors as a by-product, since for every pound of motor manufactured, there are over ten pounds of shavings. There is not a single cast piece in the Gnome engine—every part is cut from a drop forging or from the solid metal. Fig. 1 gives an idea of the cylinder blanks as they come from the drop forging hammers. Each blank weighs in the rough no less than eighty-one pounds. This weight is reduced to four and one half pounds to make a cylinder for the lightest motor in existence, for its power. Fig. 2 shows the first process of working the heavy cylinder blank—roughing out the bore. Fig. 3 depicts what was to

Fig. 6.—Workmanlike job of welding the bushing into the side of the cylinder head by autogenous process.

me the most interesting process of all—that of flanging the cylinders. Thirteen cutters, working simultaneously, produce the most highly finished and most perfectly formed flanges I ever saw on a gasoline engine. You cannot look at the Gnome motor, and be interested in engine design at all, without being lost in admiration of the beautiful machine work as exemplified in the flange construction of the cylinders. This flanging tool, Monsieur Seguin explained to me, takes just seven and one half minutes to complete its work on a cylinder, while its predecessor required almost three hours for the same job. "And," he added with a twinkle in his eye, "we had to go to Berlin for it—you Americans have nothing so rapid in operation." I replied that I noticed that most of his machine tools bore the name plates of American manufacturers, which indicated that if we could not make cylinders as rapidly as the Germans, we excelled in almost everything else. Fig. 4 illustrates the finishing process of the cylinder head. The exhaust valve screws into the end of the cylinder and may be removed, complete with its seat, for the frequent regrinding necessary to efficient operation. In Fig. 5 the grinding process is shown. After the cylinders are ground with the greatest care and accuracy, the finishing is carried still further by wearing-in the cylinder with an actual piston carrying an "obturateur." No pains are spared to obtain the mirror-like surface so noticeable when one examines the bore of a Gnome cylinder.

The bushing into which the spark plug screws is not integral with the cylinder as in a cast construction, but is welded into the side of the cylinder head by means of the autogenous process as shown in Fig. 6. An unusually workmanlike job is the result. A pile of completed cylinders is shown in Fig. 7. This engraving indicates plainly the enormous size of the hole in the cylinder head into which the complete exhaust valve is screwed. It is also evident that this construction enables the inlet valves to be easily removed, since these screw into the piston head. Both inlet and exhaust

(Concluded on page 230.)

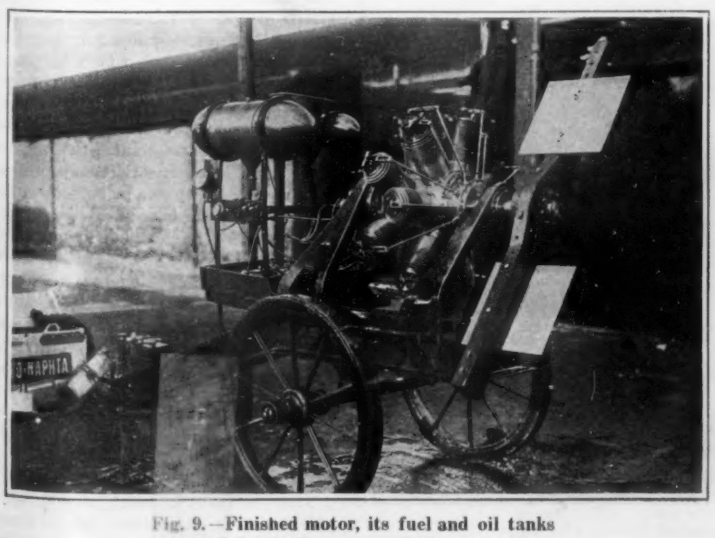


Fig. 9.—Finished motor, its fuel and oil tanks mounted for testing on a sort of gun carriage.

Fig. 10.—Method of testing at the Gnome factory. The completed motor in full movement on a trial truck.

Studying the Flying Machine in the Laboratory

Recent Progress in Experimental Aerodynamics

By A. F. Zahm, Ph.D.

As sundry detailed and unrelated accounts of modern aerodynamic laboratories have from time to time in current literature disclosed the equipment and manifold activity of these institutions, it seems advisable to have a general review of the aggregate recent development in the basic science of aerial locomotion; a review primarily of the physical results achieved, and secondarily, of the appliances and methods of investigation. No more competent scientist can be found in this country to write such a review than Dr. Zahm. He has conducted original studies which have done much to clear up some of the obscurer phases of the subject of aerodynamics, and what is more, has kept alive interest in aerodynamics by contributing admirably written and illuminating articles to the Scientific American *and other periodicals.*—Editor.

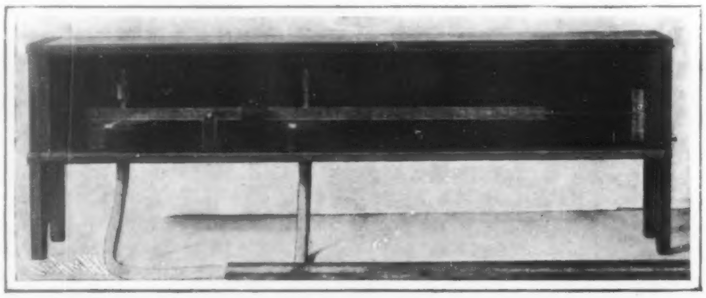
BROADLY stated, the men of the nineteenth century outlined the essential features of dynamic aerial transportation, and demonstrated its feasibility, but left to the twentieth century the arduous labor of establishing its commercial practicability. The pioneer efforts in this science comprise a long succession of valuable researches, made sometimes with simple models and sometimes with complex structures equipped for actual flight. The early methods of experiment and computation still obtain; but the old data and, in part, the old designs have needed revision, if not radical alteration. This work of refinement has occupied recent investigators no less laboriously than the making of new discoveries.

The developments of aerodynamics during the nineteenth century are of practical rather than philosophical interest. They furnish approximate laws and rough data for the engineer rather than explanations of phenomena through those intimate and fundamental relations so important to the mathematical physicist. The science of fluid dynamics must disclose not only the resultant effect on a body immersed in a medium having relative motion with it, but more especially the proximate cause of such effect, as determined by the velocity and stress at each point of the medium, both at the bounding surface of the body and in its neighborhood. The experimental investigation, however, of the velocity and stress of the air at all points about a model, though initiated in the nineteenth century, was, for thorough prosecution, left over to the succeeding one.

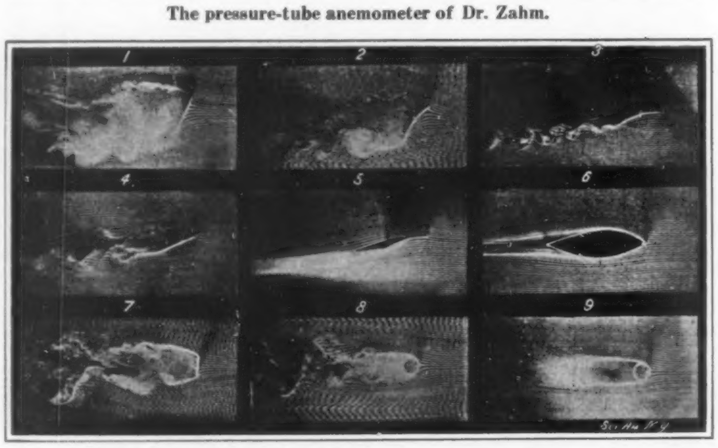
And now the ancient practice of moving the model through the air, so popular with Newton, Robins and the long line of pioneers down to the culmination of the researches of Lilienthal and Langley, was largely superseded by the practice, introduced by Phillips and Maxim, of holding the model fixed in a uniform air-stream where it can be studied by stationary instruments. The uniform current is commonly produced by drawing air through a large tube or wind-tunnel by means of a suction fan drivable at various speeds from five to fifty or more miles per hour. The usual method of eliminating swirls and irregularities of speed is to pass the air through a sheet metal "honeycomb" at the front end, and to keep the suction fan running at constant speed. In shape, the tunnel may very well be a cylinder determinated by stream-line cones, the whole raised well above the floor. If the cones be so formed as to eliminate eddies, they obviously also enhance the economy of the circulation. Assuming, therefore, a uniform current available, we may consider the means and results of various determinations of the velocity and stress in the medium, both at the surface of immersed models and at various distances away.

The very ingenious method of mapping at all points of an air-stream the complete velocity of the fluid, that is its instantaneous speed and direction, by intermittent photography of floating particles, was introduced by Prof. Marey. From the hollow teeth of a comb held squarely across the current, smoke streams one fourth inch in diameter and of a like distance apart were emitted in continuous flow extending through all the region about the model to be studied. These numerous streams showed the direction of flow in all places except where they were broken into eddies and promiscuously intermingled. They also indicated approximately the speed of flow, being crowded together where the current was swifter and expanded where it was slower. In special cases the speed was still better portrayed by causing the comb to vibrate ten times per second transversely to the current, thus giving each small stream a wavy flow whose speed everywhere was indicated by the number of waves per unit of length. The method is most instructive and would be much enhanced in value if the streams could be made to remain clearly defined and separate for, say, two yards length of flow, instead of two feet or less, as usually happens.

Marey's photographs confirm and illustrate most impressively the point-pressure and velocity indicated by theory for all the region about a model immersed in the current. In all cases of normal impact there is a point of maximum pressure and minimum speed graphically portrayed by the broadening of the smoke streams. About the sides of a model are regions where the stream lines crowd together, manifesting increased speed and lessened pressure. At the rear of the model, if of easy shape, the lines broaden again, showing increased pressure and slower speed; while if the model be of blunt form, the smoke streams portray a confused and tumultuous wake. When the stream passes by an inclined plane or arched surface, it may deviate so violently as to exhibit an elastic and undulatory movement about the model, an undulatory wake, and a pressure of pulsating intensity from point to point along the line of flow. A like effect is observed about normal planes and solid surfaces of bluff outline. Indeed, the manifestations of Marey's diagrams are so comprehensive and picturesque as to suggest that stream-line photographs should be taken in all aerodynamic investigations where the character of the movement of the fluid is not perfectly well known.



The pressure-tube anemometer of Dr. Zahm.



Marey's photographs of the air streams under varying conditions.

The suction blower at the end of Eiffel's wind tunnel, driven by a 50 horse-power electric motor.

A work of equal or greater importance, at least for applied science, is the determination of the fluid stress at every point. The point stress on any element of surface has two components; one called friction, or shearing stress, parallel to the surface, the other called pressure, or normal stress, and perpendicular to the surface. Summing these point forces all over the model gives their resultant effect tending to translate or rotate it. So important, indeed, is the separate determination of these elements of force that it may be said to constitute, along with the delineation of the stream-line velocity, the characteristic merit of twentieth century investigations in experimental aerodynamics.

As yet no adequate instrument for disclosing directly the point friction at each part of the fluid stream, whether in its depth or where it glides along the model's surface, has been employed, if indeed so much as devised or suggested. Still the friction of air, flowing smoothly at low speeds, has been determined indirectly by many physicists, and the surface friction at fairly high speeds has been found by a few students of aerodynamics. The present writer in 1902-03, by suspending a thin board edgewise in a uniform stream of air, determined the friction on the surface of various materials, in a manner resembling that of Froude's experiments in water; Francke in 1907 obtained like results by allowing thin blades to swing edgewise through the air suspended from a heavy pendulum sharpened to offer slight resistance; and Fuhrmann found the friction on torpedo-shaped models suspended in a wind tunnel, by subtracting from their total resistance the resultant pressure obtained by the manometric method presently to be considered.

The point-friction of air flowing in uniform and unconstrained current along thin smooth boards two feet wide and of various lengths and coatings was found in my experiments to diminish as the power —0.07 of the length of surface, and to increase as the power 1.85 of the speed. The magnitude of the friction was practically the same for all coatings of the board, whether glossy, dead or sticky, provided they were not rough or uneven. For rough surfaces, such as that of coarse buckram, the friction varied as the square of the current speed. On smooth two-edge posts of least resistance the resultant pressure and friction were about equal. They were also of like magnitude on hull-forms of least resistance, and on inclined planes meeting the current at an angle of a little over two degrees. The actual friction per square foot on any rectangular plane surface four feet long, in a wind blowing uniformly at ten feet per second, is 0.00050 pound, and for any other speed and length of surface can be calculated by application of the foregoing relations. A table so computed for a great variety of speeds and lengths of surface was published by the Philosophical Society of Washington in June, 1903.

The pressure intensity should be explored both in the interior of the current and where it flows along the surface of a

submerged model. For the first region no very effective instrument has been developed, though Drs. Finzi and Soldati invented a device which approximately gives both the velocity and pressure at any point in the current away from the model. The point pressure over the model's surface is very easily measured by transmission through a hole in the surface, thence to a sufficiently delicate pressure gage. The writer devised for his wind tunnel experiments ten years ago a pressure gage graduated to millionths of an atmosphere, and usually read to one ten-millionth.[1] This was applied to studying the pressure distribution over solid surfaces immersed in the wind current. Many experimentalists use as a pressure gage an inclined glass tube having a column of colored alcohol and graduated to millimeters of water, or approximately to one ten thousandth of an atmosphere, and usually read to fractional parts of a graduation. As a rule, of course, only the difference of pressure between the unchecked part of the current and each point of the disturbed part about the model has to be measured, so that the instrument need only be an accurate differential gage.

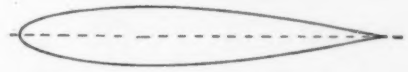
The manometric method just described has of recent years figured in a great number of important investigations. First used in the nineties, in a pioneer way, by Irminger and Vogt, by Prof. Nipher, and by Mr. Dines, it was next employed at the beginning of this century in the elaborate investigations of Drs. Finzi and Soldati of Milan, to reveal the pressure distribution over inclined plates, both arched and plane, also spheres, cylinder and spindle forms. It has been since used in the careful and accurate measurements of Stanton in England, Prandtl in Germany, and Eiffel in Paris, not to mention various others. The resultant pressure so obtained for normal impact was found to agree satisfactorily with that given by an aerodynamic balance in which the wind force on the model was measured directly by equilibration against a known force, usually a weight or spring tension.

The results of numerous experiments on normal impact, made in these various laboratories, exhibit a general uniformity of characteristic features. Calling ρ the density, v the velocity of the air, all the measurements disclose a maximum pressure equal to $\rho v^2/2$ at the front center of the exposed plate, a more and more rapidly waning pressure toward the front edges, and a practically uniform pressure over the back, varying indeed with the shape, but bearing for various plates no fixed relation to the front pressure. All show that in air of any given uniform speed and density the pressure intensity is practically the same at all similar points of similar plates whatever their size, beyond a square yard, and hence that the resultant pressure is substantially proportional to their area.[2] But for dissimilar shapes the mean pressure is shown to be as much as fifty or sixty per cent greater on elongated plates than on square ones of the same area. All experiments, of course, show that the resistance varies directly as the density and square of the velocity of the air. As to absolute magnitude, there is not such close concordance, but the most accurate measurements give for a foot square blade, at normal air density, a resistance not far from $0.003V^2$, in which V is the velocity in miles per hour.

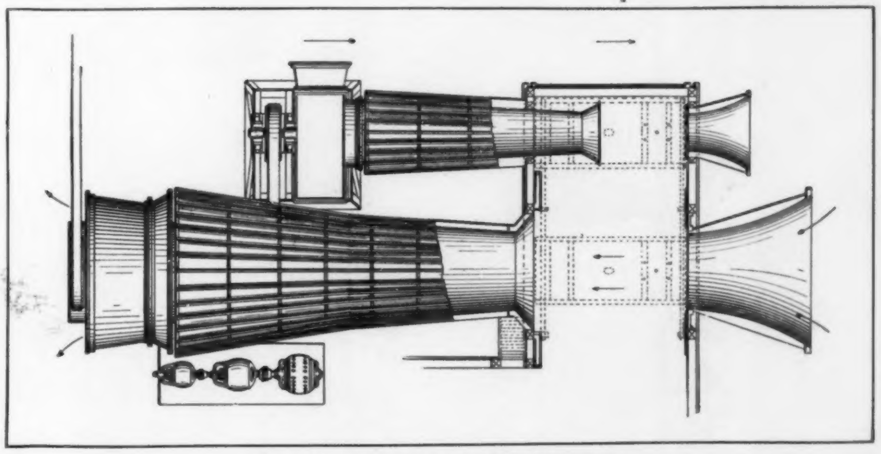
All measurements on inclined plates likewise accord in some important general disclosures. They show that oblique flat plates have sundry properties common to oblique concave ones, and also certain marked differences. Both kinds encounter more resistance when of elongated form and set long edge foremost; both manifest a varying pressure distribution on the face, and a varying suction on the back, usually of greatest intensity near the front edge; both exhibit feebler pressure and suction near their lateral edges, owing to the lateral escape of air. But flat plates have a resultant pressure whose magnitude at small angles of incidence increases directly as the angle, and whose position travels forward with increasing obliquity; while arched plates have a resultant whose magnitude varies in no simple manner with the obliquity, and whose position retreats as the small angles of incidence diminish, wherefore such forms tend to dive precipitately.[3] Flat inclined plates are less efficient carriers than arched ones; they also leave behind a tumultuous wake, entailing loss of power, while arched ones deflect the air-stream smoothly and leave an unruffled, though doubtless an undulatory, wake. For this reason good arched forms require less propulsive force for a given lift, and in some excellent designs carry ten to fifteen pounds of weight per pound of thrust.

The measurements made on elements of hulls and framing of air craft have shown that these also can be so shaped as to reduce the resistance in a like degree. A stream-line hull of torpedo form can be made to meet a resistance of less than one tenth, probably less than one fifteenth, that of its major circle. The same may be said of the resistance of sharp stream-line posts and rods as compared with their major sections taken squarely to the wind. The tendency in designing fast air craft is, therefore, to give stream-line shapes to all exposed elements, and to encase all parts that need not be exposed, or that do not admit of sharpening. But the practice of polishing to eliminate friction seems futile, since a glossy surface has the same friction as a dead one, other things equal.

As the prescribed limits of this article have now been exceeded, nothing can be said of recent investigations on propellers, and on shapes and devices to insure the stability and steadiness of air craft. It is, however, worth remarking that the ablest designers to-day eagerly study the investigations made in the great aeronautical laboratories, and, even if they do not engage in such work, as did their predecessors up to the advent of public flying, they promptly turn it to profit, realizing that the adequate test of an aerodynamic model, besides being easy and economical, furnishes a secure basis for predicating the performance of a full-size machine.



The hull of least resistance.



Plan of the Eiffel aerodynamic laboratory.

The large and small wind tunnels are shown side by side. Their diameters at the experiment room are 2 and 1 meter, respectively.

[1] Measurement of Air Velocity and Pressure, *Physical Review*, December, 1903.

[2] For areas below a square yard the coefficient of resistance diminishes slightly with the area.

[3] As an aeroplane flies downward more steeply and swiftly its angle of incidence diminishes more and more; and if the surface be concave the center of lift on the wing moves well back, tending to steepen the dive. This fact may explain some noted cases of loss of control in downward flight.

Russian Bast and Its Uses

RUSSIAN bast is the trade name given to the fibrous inner bark of the European linden tree (*Tilia europea*). This tree abounds in the forests of Europe and finds its best development principally in the western central provinces of Russia. It is very closely related to the American linden or basswood (*Tilia americana*), and is a favorite for planting in parks and along streets, both in Europe and in this country. The European linden is remarkable for the abundance and fine quality of fiber it contains in the inner bark. Enormous quantities of this bast fiber are gathered every year and exported. In fact, it constitutes one of the most considerable by-products of the forests in central Europe.

Stripping the bark from the trees lasts from the middle of May to the middle of June. This is the period when the bark is most easily removed from the stems and branches. When the bark is whole it is employed for roofing, for the river boats, as well as for making sledges, carts, boxes, etc. When it is removed in several pieces it is used for matting and bags. The bark of the young linden trees is used for making cordage, sandals for the peasants, and for all sorts of baskets, etc. The trees must be at least three years old before they are large enough to be peeled for making shoes. To every pair of shoes from two to four young linden trees are required.

The trees from which the bark is removed are felled during the following summer or fall and the wood converted into charcoal, which is said to be of very good quality and is highly prized by the manufacturers of gunpowder. The young forests of this species are thus being rapidly destroyed in consequence of this enormous use of linden bark procured from the promising young trees. The bast of still larger trees is used for other purposes. For instance, trees from eight to sixteen years old are cut for making mats. The bark is first cut or divided longitudinally into strips from 4 to 6 feet long and then raised with an instrument made of bone, after which it is easily torn off with the hand. When the bark is removed it is stretched on the ground to dry, two or three strips being laid one over another and kept straight by being tied down to long poles.

The bast for foreign consumption is made into mats which are generally about six feet long and three feet six inches wide. These are used especially for packing large objects as machinery and furniture. Excelsior and other packing material have during more recent years been substituted for bast. Immense quantities of bast are consumed by gardeners in Europe. About twenty-five years ago the annual production of bast in Russia amounted to about 14,000,000 mats, and about one fourth of these were for export.

When the bark is to be used for cordage or for cloth it is first steeped in water for several days until the cortical layers separate from each other. The best and strongest fibers are in the layers next to the wood, and the coarsest and weakest are nearest the outside. After the fiber has been macerated it is employed in England for making stout ropes, in France for well ropes and clothes lines, and in Sweden for fishing nets, for which purpose its durability eminently fits it. Russian bast is used also for making excellent paper of remarkable smoothness. Formerly gardeners used it very extensively all over Europe and in this country as a covering or protection to glass frames. Its use for this purpose has fallen off considerably since the introduction of raffia, which has become so popular in nursery work and green houses for tying up young trees and garden vegetables. It is still used in Russia for making baskets, hampers, and prepared fiber for hats and cordage of the finest quality. Like the closely related Japanese linden tree (*Tilia cordata*) it is sometimes used for making a coarse cloth and in the manufacture of mosquito nets.

The continual destruction of the young trees through this wasteful practice of removing the bark naturally diminished the supply. The peasants in a good many regions where the trees grow still utilize the bark for numerous purposes, but other material will gradually be substituted, and the bast only of merchantable trees utilized for making superior grades of paper. The wood itself is very white, light, close-grained, and is used for interior finishing, carving work, barrel heads, and in the manufacture of carriage boxes, cheap furniture, etc. Quite a demand has recently sprung up for linden wood, both in this country and in Europe, by the manufacturers of cigar boxes. This at once rendered the wood too valuable for the trees to be cut before they have attained merchantable sizes. There are many other uses for which it is especially adapted, and the value of the wood has now surpassed that of the bast.

Rolling Lead by Electricity

LEAD is now worked in the Beuthen plant in Germany by means of electric motor-driven rolls, these having been driven by steam up to a recent date. There are now two separate rolls used for producing sheet lead of various sizes. On the smaller of the two rolling mills is used an electric motor running at 345 revolutions per minute with a double gear reduction, the rolls being 10 feet in length and 18 inches diameter, and running at 5 revolutions per minute. The second set of rolls is 12 feet long and 21 inches in diameter and works at 7 revolutions per minute by means of a 60 horse-power electric motor. Worm-gear reduction is used in this case to reduce the motor speed from 345 revolutions per minute to the above. The electric motors are operated directly on a high-tension circuit of 2,000 volts and are equipped with starters placed in an oil bath. On the tests of the present rolls it was shown that when starting with a 7-ton lead plate of 6-inch thickness, working at a heat of 100 deg. Cent., the width of the plate being 6 feet, about 65 horse-power is required to roll this down to a 0.12-inch thickness. On the whole, the electric driving is considered as much the best method for this kind of plant.

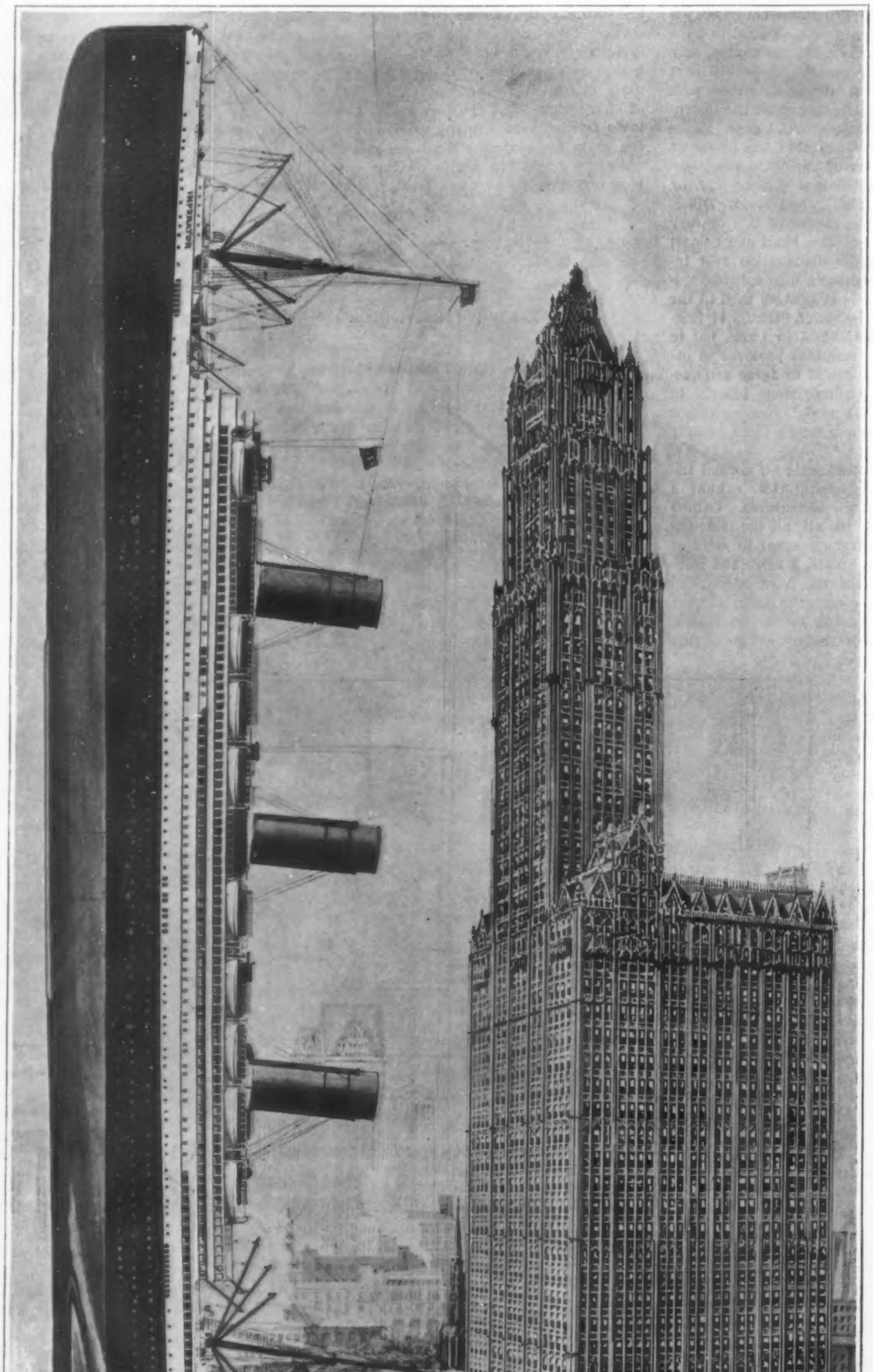
The Biggest Ship

IT is easier to realize the dimensions of big constructions on land than of those afloat on the sea. The tall building, for instance, looks its size; for it stands amid other structures, with whose dimensions we are familiar and by which we can gage the stupendous proportions of the sky-scraper. But when the giant steamship is afloat upon the high seas it is seldom that there is any object in her vicinity which serves to convey to the mind an adequate sense of her great proportions.

It is for the foregoing reason that the artist has taken the liberty of upending the largest steamship in the world, and standing her side by side with the world's tallest building. The result is certainly Brobdingnagian and well calculated to impress the man on the street with a sense of the huge dimensions of length, breadth and depth, which characterize modern steamships of the largest size.

The Woolworth Building, which for the time being holds the distinction of being the tallest office building in the world, is certainly a most imposing structure. Architecturally, of course, it may be open to objections on grounds of æsthetic taste; although, in justice to the architect, we must confess that in view of the severe conditions imposed upon him we consider that he has produced a very creditable result. The Woolworth Building stands on a plot about two hundred feet square, and it rises to a sheer height of seven hundred and fifty feet above the sidewalk. Had the tower stood in the center of the mass, instead of rising from the center of the Broadway façade of the building, the total result would have been better; but it was not until after the building was started that additional land to the westward was secured—this at a time when it was too late to alter the original location of the tower.

To anyone who is not familiar with the exact dimensions of the largest ocean liners, it would seem impossible, as he gazed skyward to the finial at the top of the Woolworth Building, that any ship, if stood on an end, would reach so far into the heavens—certainly he would be staggered to learn that the big Hamburg-American liner would out-top the pile by no less than one hundred and fifty feet.



The "Imperator" 900 feet, Woolworth Building 750 feet.
THE LONGEST SHIP AND THE TALLEST BUILDING

What is Miasma?

IN a remarkable lecture at the University of Geneva Dr. A. Trillat, of the Pasteur Institute in Paris, recently expressed the view that the old idea of "miasma" in relation to disease is in a great measure reconcilable with our present theories as to the nature of infection.

From ancient times down to the middle of the nineteenth century infectious diseases were supposed to be due to a corruption of the air, especially as resulting from putrefaction. Thus a certain epidemic at Venice was traced to an accumulation of decayed fish; one at Delft to spoiled cabbages, etc. The idea of a bad odor was inseparably connected with the vitiated air, or miasma, that spread infection; hence, the wide use of deodorants as a means of protection.

Doctors and priests, required by their professions to minister to the plague-stricken, carried perfumed torches, incense-burners, and the like; houses and towns were disinfected by burning various substances that were supposed to neutralize the poison in the air. Fires in general were supposed to be disinfectant. Hippocrates caused fires to be lighted in the streets of Athens to allay the plague. The burning of juniper berries was a favorite means of fumigation. Another was to sprinkle vinegar on hot stones, the resulting vapor being regarded as a sovereign disinfectant.

With the advent of bacteriology the idea of miasma as a cause of infectious diseases naturally fell into disrepute. Since these diseases became regarded as the work of various micro-organisms, disinfection was henceforth applied directly to the destruction of disease germs. The point that appears to have been lost sight of, according to Dr. Trillat, is that although noxious gases are no longer looked upon as the direct cause of infection, yet they may greatly promote the process by providing a favorable medium for the development of bacteria. The lecturer described a number of experiments that he had carried out to ascertain the effects of the gaseous products of putrefaction on the vitality and fecundity of pathogenic bacteria. Without repeating the details, which will be found in the *Archives des Sciences physiques et naturelles* for June 15th, 1912, it may be stated that the development of the germs of diphtheria and plague was found to be remarkably stimulated by their exposure to air containing small traces of putrid gases. The experiments were first tried under laboratory conditions; then confirmed by exposing similar bacteria to the products of natural putrefaction out of doors, as in the neighborhood of marshes, sewers, and the like.

The upshot of these experiments appears to be that the development of pathogenic bacteria is greatly affected by the composition of the atmosphere. The subject is by no means simple; one species of bacterium may be very differently affected from another by a given gas. Nevertheless, it seems likely that many now obsolete methods of disinfection may be rehabilitated as a result of further studies in this direction.

M. Trillat is responsible for the opinion that the rapid souring of milk and putrefaction of meat during thunderstorms is similarly due to a change in the composition of the atmosphere at such times, and not at all to electrical discharges, as has often been held. According to his view, the diminution of barometric pressure accompanying storms promotes the release of putrid gases from the soil, and these gases stimulate the development of the bacteria concerned in the two processes in question.

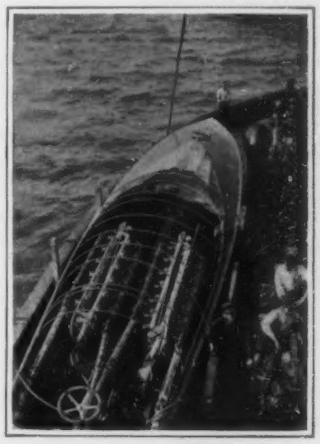
THE British Consul at Calais reports that a French company is seriously considering the project of a passenger aeroplane service between Calais and Dover, and has made proposals to the municipality of the latter town as to the selection of a suitable landing place.

The "Ankle-Deep" going 40.3 miles an hour.

The Race for the Harmsworth Cup

The Technical Lessons of a Great Contest

By Thaddeus S. Dayton



The engines of "Maple Leaf IV."

As the English-built "Maple Leaf IV" shot across the finish line on Huntington Bay last Wednesday, winning the international motor boat trophy offered by Lord Northcliffe, which has been held by this country since 1907, Commodore H. H. Melville, chairman of the Board of Governors of the Motor Boat Club of America, challenged the Royal Motor Yacht Club for a return race in British waters next summer. The contest that has just ended taught some very simple but highly important lessons to the American builders and owners of sea-speeders. These will be heeded carefully, and everyone is hopeful that next year the Harmsworth Cup, as it is called, will be recaptured, and that it will be a long time before it crosses the Atlantic again.

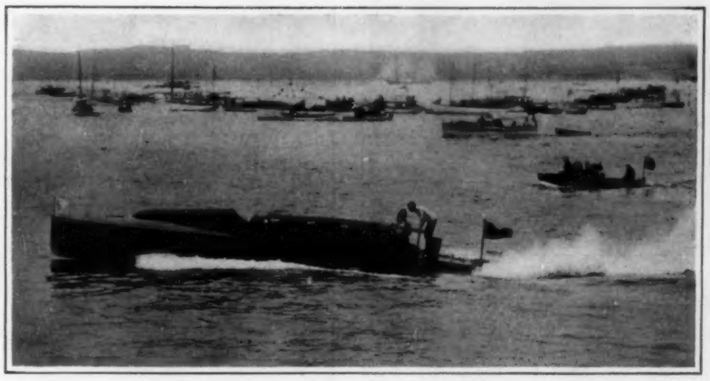
To understand what these lessons were, a brief *résumé* of the three races that resulted in a British victory is necessary. The first "leg" of the three contests was run on Saturday, August 31st. There were three American and two British entries. The American boats were "Baby Reliance II," owned by J. S. Blackton; "Baby Reliance III," owned by Mrs. J. S. Blackton; and "Ankle Deep," owned by Count C. S. Mankowsky. The British boats were the "Mona," Marquis of Anglesey owner, and "Maple Leaf IV," the property of E. M. Edgar.

"Baby Reliance II" is a black-hulled boat, twenty feet long, driven by one motor of eight cylinders and one hundred and fifty horse-power. Bernard Smith was the helmsman and W. Bugh the mechanician. "Baby Reliance III" is twenty-six feet long, driven by a motor similar in size and make to that in "Baby Reliance II." Jay Smith was her helmsman and Wallace Van Nostrand the mechanician. "Ankle Deep" is a Crane designed boat, finished bright. She is thirty-two feet long, driven by two motors of eight cylinders each, her total horse-power being three hundred. She has two propellers and two rudders. Count C. S. Mankowsky steered the boat. His mechanician was Frank Drennon.

The British boats are both built of mahogany and finished bright. The "Maple Leaf IV," 39 feet 11 inches long, is a Fauber multiple-step hydroplane, driven by two sixteen-cylinder motors of three hundred and fifty horse-power each. She has two propellers and two rudders. Tom Sopwith, the aviator, was helmsman and Arthur Allison mechanician. The "Mona" is twenty-six feet long, Thornycroft designed, driven by a motor of one hundred and fifty horse-power. Montague Batting, her designer, had the wheel, and Frank Murtagh, who was in the "Pioneer" last year, was mechanician.

The course was thirty nautical miles, or four times around a triangle of seven and one half nautical miles, in the sheltered waters of the bay. The weather conditions of this first day's race were ideal for the American boats. At no time was the water ruffled enough to make the going bad.

This first contest was won by "Baby Reliance II" in forty-eight minutes and thirty-nine seconds. Her average speed was 37.11 nautical or 42.73 statute miles per hour. She finished seven minutes thirty-nine seconds ahead of the "Mona." The "Maple Leaf IV" had engine trouble and started more than twenty-one minutes late. All she tried to do was to qualify for the next race. "Baby Reliance III" and "Ankle Deep" also had engine trouble, and came in fourth and fifth.



"Maple Leaf IV." Winner of the Harmsworth Cup.

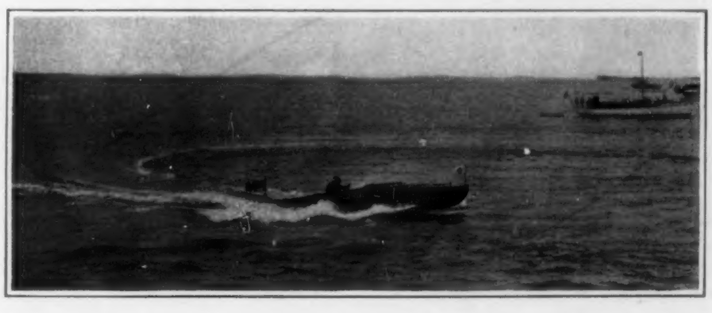
She is 39 feet 11 inches long. She has two propellers and two rudders.

"Maple Leaf IV" at full speed.

Note the height of the wave that she is dashing up.

"Baby Reliance II."

She is 20 feet long, and is driven by a 150 horse-power motor.



"The Mona" making one of her remarkably short turns.

She is 20 feet long and is driven by a motor of 150 horse-power.

"Baby Reliance III" at full speed.

She is 26 feet long and driven by a motor similar in size and make to that of "Baby Reliance II."

The following Monday, when the next heat was scheduled, the weather was so rough that it was agreed to postpone the contest until next day. The victor was the "Maple Leaf IV," "Mona," second, with "Ankle Deep," "Baby Reliance III," and "Baby Reliance II" finishing in the order named.

The wind and sea had been high the day before, but on the afternoon of the race the wind dropped to a gentle breeze. Out on the Sound, however, along the edge of which the boats had to go, there was an ugly swell left over from the northeast gale. The "Ankle Deep" got away in the lead, with "Baby Reliance III" a few seconds behind and the "Maple Leaf IV" three seconds later, her exhausts silent and only the "singing" of her powerful motors to be heard as she plowed a great wide furrow of foam and spray. "Baby Reliance II" was in trouble with her engines and crossed the starting line more than three minutes late. The "Mona" was even worse off, for she was unable to reach the start for eight minutes and seven seconds.

When the boats struck rough water, running west on the base of the triangle, the three American boats got in trouble again and had to stop. Then "Maple Leaf IV," going as steady as a church, took the lead and never was headed after that. The "Maple Leaf IV's" average speed was 27.17 knots (31.24 miles); the "Mona's," 29.13 knots (38.49 miles); "Baby Reliance II," 25.27 knots (29.06 miles); "Baby Reliance III," 25.06 knots (28.81 miles). It should be noted that "Maple Leaf IV's" average speed was more than eleven miles less than that of "Baby Reliance II" in the first heat when the water was smooth.

On Wednesday, the day of the deciding heat of the race, the conditions again were ideal. The greater portion of the course was like a mill pond with just enough breeze to help tone down the heat of the blazing sun. It was "Reliance" weather and water, and everyone was confident that the trophy would remain with us for another year at least. The "Mona" was the first to cross the starting line; a dozen seconds later "Ankle Deep" boomed across, and then, seconds apart, "Reliance II" and "Maple Leaf IV" shot by at their best speed. "Reliance III" had trouble in getting her engines awake, and was the last to start.

Up the first stretch "Ankle Deep" overhauled "Mona," and "Reliance III" also passed the British boat. "Reliance II" put her best foot foremost and began to gain on "Ankle Deep." Down the back stretch these two boats raced a length apart, plunging heavily in the water. "Maple Leaf IV" kept up a uniform pace behind them. "Reliance II" finished the

(Continued on page 232.)

New Metallizing Process

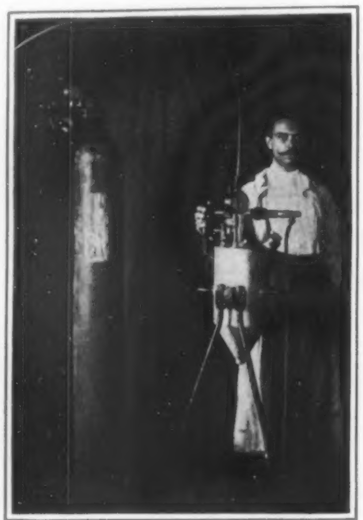
By Dr. Alfred Gradenwitz

DR. SCHOOP, of Zurich, Switzerland, was watching his children at play with a Flobert rifle when he chanced to note that the bullets striking a wall were crushed thereon, producing a strongly adhering lead coating. This led him to make some experiments with small shot, which brought out the fact that the grains of lead on being crushed form a practically homogeneous layer, provided their surface is cleansed and freed of any trace of graphite.

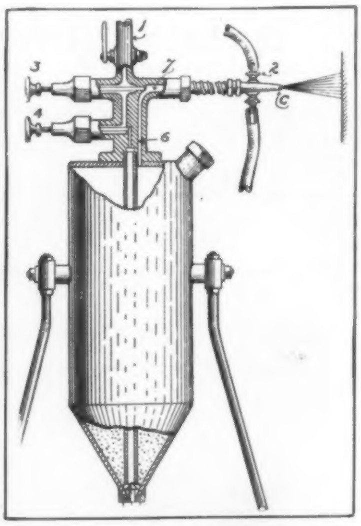
Although this metallizing process was announced some time ago, the details of the process and the apparatus it requires have only just been made public. In the first metallizer constructed by Dr. Schoop, molten metal was pulverized by a jet of high pressure steam, and projected in a stream of spray upon the object to be coated with metal. This, however, required a stationary apparatus. In the portable apparatus, the molten metal is replaced by a metal powder, which is carried along by a jet of steam or of compressed gas. The jet of gas is heated either by means of a flame or an electric resistance or arc. The particles of metal powder are shot out of the apparatus by means of a jet. The object to be coated with the metal is thus bombarded with a hail of fine metallic particles. At the moment they strike the surface there occurs a transformation of live energy into heat, and this heat contributes to liquefying the particles so as to solder them to one another.

A very convenient form of portable apparatus is represented in the diagram. The mouthpiece C, from which the jet heated by a gas flame is blown forth, is fixed at the end of a flexible tube. The gas enters through the valve 2, into an inner tube fitting concentrically with the passage 7. The air, which is generally at a pressure of five atmospheres, passes through the tube (1) into a chamber fitted with two valves (3) and (4). By turning the valve (3) compressed air is admitted directly into the passage (7), and by operating the valve (4) it is led into the lower half of the apparatus, where it produces a whirl of metal powder, carrying along some of the powder into the conduit (6), then into the conduit (7), and finally into the flexible tube connected with the mouthpiece. The apparatus is mounted to turn on a horizontal axis, so that the last traces of metal may be removed by the compressed air, by tipping the apparatus on its axis.

The apparatus is started by opening the gas valve (2) and igniting the gas. The compressed air admission having been opened, the valve (3) is adjusted until a satisfactory flame is obtained. Then the valve (4) is opened so as to introduce the metal powder. In order to insure a really homogeneous layer, it is essential that no oxide film covers the particles. This is why an inert or even reductive gas and electric heating are used in connection with highly oxidable metals. A striking feature of the operation is that the expansion of the gas is attended by a strong cooling which solidifies the metal rapidly, while the surface temperature remains low; in fact, with such metals it is below 60 deg. Cent. (140 deg. Fahr.). This is why inflammable substances, such as celluloid, as well as flowers and fruits can be metallized. The thickness of the deposit may vary between a hundredth of a millimeter and several millimeters, depending upon the surface to be coated, and on the relative speed of the jet. The latter also governs the hardness and density of the metal coating. This system of metallizing has been used for forming accumulator plates; constructing resistances in the form of a metal thread of zigzag shape; obtaining electric contacts instead of soldering them; and metallizing the clothes of electricians. This last is a very interesting application. If the clothes of electricians are metallized they are protected against high tension current, as in the event of a contact the current would pass through the metallized surface and not through the body of the electrician.



Apparatus adopted by several large French works for zinc, lead and copper plating.



Details of the apparatus for depositing pulverized metal.

NEW METALLIZING PROCESS

The Electric Tow-horse

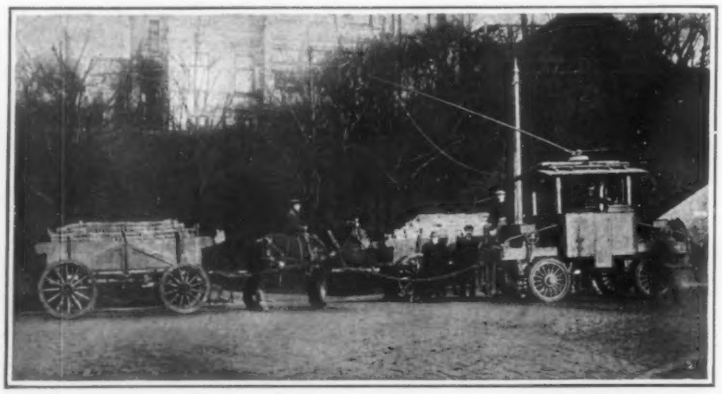
THE management of the port of Altona had for some time past to face a rather difficult problem that baffled many attempts to solve it. The question was how to transport the wares unloaded at the harbor over two roads of a heavy gradient. As only horse vans had so far been used in this connection, it was considered impossible to replace them all by motor trucks. On the other hand, the horses drawing these heavy loads over mountainous roads proved more and more insufficient to fulfill their task. Finally a compromise between motor and horse traction was settled upon.

In Europe trackless trolley lines are coming more and more to the fore as a welcome substitute for street tramways. Being independent of any strictly limited course and much cheaper in installation, this means of transport doubtless possesses a number of advantages and is operated on a profitable basis where a rail line would not pay.

The new hauling service of Altona harbor then is based on this system. It is adapted to deal with an average daily traffic of 200 vehicles, each carrying a load of from 5 to 7 tons over two paved roads each about 600 meters in length, which lead at a gradient of 1.18 from the harbor over Kaistrasse and Elbberg as far as the city hall. The pushing and hauling tractors used in this connection are operated by electricity, being fed through a double pole overhead line with 550-volt direct current from the municipal central station. They travel without rails, being able by their trolley arrangement to deviate sufficiently to pass other vehicles. On going downhill, these locomotives travel with the trolley removed.

A train of two or three teams can be hauled by the electric tractor. The horses are not unhitched, but follow in the hauling train, being merely relieved by the hauling locomotives. The coupling devices are so arranged that the vehicles can be uncoupled without stopping.

Each journey of a hauling train, inclusive of the coupling and uncoupling, takes 8 minutes, and as the downhill course takes 7 minutes, four trains can be dealt with each hour by a single tractor.



THE ELECTRIC TOW-HORSE HAULING A TRAIN OF TRUCKS

Swedish Method of Artificial Restoration to Life

By the Paris Correspondent of the Scientific American

A SIMPLE and convenient apparatus for producing artificial respiration has been invented by Dr. K. A. Fries of Stockholm. It is likely to be valuable in restoring animation after asphyxia.

The apparatus is made up of a wooden base in the form of a shield with a part at one end for resting the head, and to this is fitted a light steel frame consisting of a pair of uprights joined by a cross-bar. On the bar are automatic clamp straps for fastening the arm. On the chest a canvas girdle or band is placed so as to compress this part of the body, adjusting properly for size by means of eyelets. The device is first laid on the floor or table and the metal frame folded out, laying the patient on the base, and the wood head-piece then adjusts the head and throat automatically in the right position. We then apply the girdle on the lower part of the chest and fit it snug by the hook and the cord. Adjusting the cross-bar to a good height, we strap the wrists loosely to it, as our engraving shows, then the frame is ready to be operated for producing respiration. The frame carries chains and cords which connect its movements by means of pulleys with the chest girdle, so that the chest is compressed at the right time.

The work of respiration is begun by extending the levers horizontally backward so as to produce inspiration, and in this position the chest girdle lies loose. We then draw up the levers to the vertical and bring them down toward the lower part of the body so as to give the expiration, and here the cords and pulleys act so as to compress the chest band and aid in expelling the air from the lungs. At the same time the patient's tongue is drawn outward by the other hand by means of a handkerchief or ring forceps. The movements are kept up regularly back and forth, keeping time with one's own breathing, or about 16 times a minute.

The device is very compact and can be folded up so as to occupy a space of three feet by two feet by four inches, and may be hung on the wall or stowed away anywhere.

Working apparatus with one hand, and attending to the tongue with the other.

The device and patient ready for the operation. Method of fixing the arms.

The complete apparatus in position for use on the table.

Strapping the wrist bands to the cross-bar. The girdle shown tight across the chest.

SWEDISH METHOD OF ARTIFICIAL RESTORATION TO LIFE

"Chemiluminescence"—the Transformation of Chemical Energy Directly into Light

By F. Alex. McDermott, Research Fellow in Utilization of Fruit Waste, University of Pittsburgh

THE term "Chemiluminescence" has been applied to the production of light by chemical reactions in which the temperature is below that of incandescence. The most common illustration of this is the luminosity of phosphorus and its solutions in various liquids, which give light when exposed to the air. It is probable that the phenomenon of the firefly and similar forms belongs strictly in this class. A considerable number of reactions have been at various times described as giving light under conditions precluding the possibility of incandescence, and an exhaustive review of these has been given by Trautz in the *Zeitschrift für physikalishe Chemie*, Vol. 153, pages 1 to 111, 1905. For the most part, however, the lights emitted are rather faint, and often, unless the conditions of the experiment are just right, no light is produced. The three following experiments are rather easily carried out in any laboratory, and may prove of interest to some of the readers of this paper:

1. The reaction of Trautz and Schorigin (see Trautz, supra, and Trautz and Schorigin, *Zeitschrift für wissenschaftliche Photographie und Photochemie*, 1905): This depends on the rapid oxidation of an alkaline solution of pyrogallol containing formaldehyde. The apparatus which the writer has used to show this reaction consists of a reflux condenser *D* with a bulbed condensing tube, set horizontally, and two or three separatory funnels. (See figure.) In a funnel *A* is placed a solution of 12.5 grammes of pyrogallol in a mixture of 25 cubic centimeters of commercial formaldehyde (37 per cent) solution with 50 cubic centimeters of water; funnel *B* contains a 40 per cent solution of sodium of potassium hydroxide; a third funnel *C* (not shown in figure) contains "Perhydrol" (30 per cent hydrogen peroxide solution). In place of this latter, the usual pharmacopeial 3 per cent solution may be used, in which case this third funnel must be much larger than *A* and *B*, and the inlet for the peroxide solution into the condenser must be larger, to permit of more rapid flow. A solution of hyperol, the urea-hydrogen peroxide compound, made by Richter, Budapest, may be used with advantage in this reaction. A solution of ten or twenty grammes in about 50 cubic centimeters of distilled water will produce a good light. Still more simple, instead of funnels *B* and *C*, a single funnel may be used, as shown in figure, containing 150 cubic centimeters of distilled water in which about 40 grammes of sodium peroxide have just been rapidly stirred. In place of the condenser, a simple glass tube may be used, one of 2 centimeters internal diameter being convenient; the advantage of the bulb tube is that it tends to delay the passage of the liquids to the exit, permitting the greater part of the light-emisssion to take place in the tube.

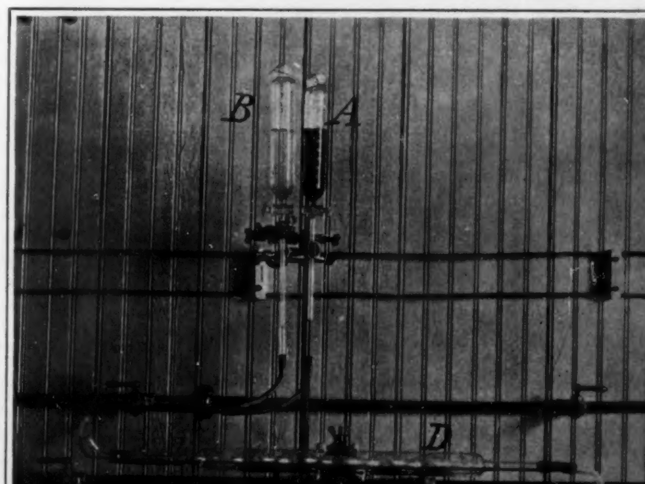
To operate, the stop-cock on *A* is opened so as to allow a slow stream of the pyrogallol solution to flow into the mouth of the condenser; the stop-cock on *B* is then opened so that the alkali solution will flow about as rapidly as the pyrogallol; *C* is then opened so as to permit the peroxide solution to flow down and come in contact with the mixed liquids from *A* and *B*. If the solutions are right, a stream of light will be seen to travel along the condensing tube of the condenser. The light is not by any means as bright as that of the firefly, and this experiment must be performed in a dark room, as must also the following one. The reaction is accompanied by the evolution of quite a little heat, and formaldehyde is evolved. Owing to the formation of dark colored oxidation products of the pyrogallol, the light will appear reddish in color. A little manipulation of the stop-cocks may be necessary to secure the proper results.

2. The reaction of Heckzo (*Chemiker Zeitung*, Vol. 35, p. 199). This reaction depends on the oxidation of phenyl magnesium bromide or iodide by moist air. It is necessary first to prepare the reagent, phenyl magnesium bromide (or iodide) which may be done by the method given in Heckzo's paper. The apparatus necessary is very simple; the compound, in solution in anhydrous ether, may be simply shaken with air in a test tube, or it may be poured onto a piece of moistened filter paper, or it may be allowed to drop from a funnel onto a moistened filter paper. The light is pale greenish, and of about the same intensity as that of the foregoing reaction.

Wedekind has found that when this compound is added to an ethereal solution of chlorpicrin (nitro-chloroform), a green "flame" is produced, which does not ignite the ether.

3. The reaction of Schwersenski and Caro (*Chemiker Zeitung*, Vol. 22, p. 58). This reaction is quite brilliant, and depends on the oxidation of certain organic substances by the gases evolved from potassium permanganate by the action of sulphuric acid. It seems possible that it is not strictly a case of "chemiluminescence," and that the phenomenon may be referable to actual incandescence. The original directions of the authors referred to were to place in a test-tube 3 cubic centimeters of concentrated sulphuric acid, and then to overlay this with three cubic centimeters of alcohol, running the latter in slowly from a pipette, so as not to mix the liquids. A crystal of potassium permanganate is then dropped in, producing an evolution of gas in the acid layer; when the ascending bubbles of gas reach the alcohol layer, they "go off" with a little explosion and a bright flash. After a number of experiments by the writer, it has been found that in place of alcohol, a better reaction is usually obtained with ordinary formaldehyde solution, the permanganate being dropped into the acid before the formaldehyde is run in over it. (Potassium permanganate reacts with formaldehyde, and hence it is impossible to drop it into the acid after the latter has been overlaid with the aldehyde.) Using about 10 cubic centimeters in a test tube 25 millimeters in inside diameter is quite safe; larger amounts are objectionable, on account of the fact that should the tube be accidentally upset, the formaldehyde or other vapor will usually be ignited, especially if larger quantities are used.

In place of ordinary alcohol or the formaldehyde solution, any of the following may be used, though usually with not quite so good results, on account of greater volatility, secondary reactions, or slow reaction; methyl and amyl alcohols, acetone, acrolein and acetaldehyde solutions, lactic acid, amyl acetate, nitrobenzene. Orange oil, aniline, terpineol, and solutions of vanillin, citric acid, cane sugar, and of dextrose also give the reaction slightly on shaking, but these are unsatisfactory for demonstration. Benzene, urea, acetamid, acetic acid, and probably also, pure ether, do not show this reaction. While a discussion of the intimate chemistry of these reactions would be out of place here, it might be added that in all three it seems not unlikely that it is connected with the presence or formation of aldehyde groupings.

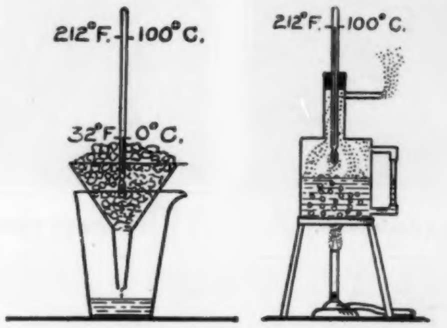


Demonstration of chemiluminescence by Trautz's reaction.

How to Correct a Thermometer

By Norman Barden

THERE are times when the home thermometer varies from that of the Weather Bureau. Invariably it is asserted that the weather man's thermometer is wrong; but let us see whether this be true or not. It is intended here to explain clearly how anybody can correct his thermometer by finding the fixed points. The fixed points are the freezing and boiling points. The freezing point is the true fixed point, because the boiling point varies with barometric pressure. The variation of the boiling point must be allowed for, as we shall see later.



Determining the boiling and freezing points of a thermometer.

To determine the boiling point, place the thermometer in position in a boiler as shown in the drawing. Have the boiler about one half full of water, and be sure that the bulb of the thermometer does not touch the water when boiling. Now the water is boiled, and the temperature is taken to tenths of degrees if possible. A magnifier aids greatly in taking temperature readings. Next take the barometer reading, and calculate the true boiling point by means of the formula:

$$T = 100 - 0.0375\ (760 - b)$$

in which b is the barometer reading in millimeters, and T is the temperature of the observed boiling point in Centigrade degrees. Example: Supposing b to be 732.4 millimeters, then solving for T, we get 98.965 deg. Cent.; which is the true boiling point for 732.4 millimeters pressure. The difference between the true and observed boiling points is the boiling point correction.

The freezing point is found by packing the thermometer in finely crushed ice. Leave the thermometer in this position until the mercury ceases to fall. Take an exact reading as before, using the magnifier, and this is the true freezing point or zero. Now, divide the number of degrees between the observed zero and the true boiling point by the number of degrees between the observed zero and the observed boiling point. This gives the thermometer correction per degree. Example: Suppose the observed boiling point was 98.8 deg. Cent., and the true boiling point was 98.9 deg. Cent., also that the observed zero was exactly at zero degree on the thermometer. Then,

$$98.9 \div 98.8 = 1.001,$$

or the correction of one degree. That is, if the temperature on the thermometer read 1, the real temperature would be 1.001 degree; or if the temperature read 20 degrees, the real temperature would be 20×1.001, or 20.02 deg. Cent.

Most thermometers will have a correction of a degree or more. In this article Centigrade readings have been used, but the method for Fahrenheit thermometers is just the same. If it be desired to convert Fahrenheit into Centigrade or *vice versa*, this may be done by substituting in the following formulas:

$$F = \frac{9\ (C - 32)}{5} \qquad C = \frac{5\ (F - 32)}{9}$$

It will be found quite interesting for those who have never tried to find the true freezing and boiling points, to correct one's thermometers in the manner described, and then have the satisfaction of being able to find the correct temperature at any time.

An Inexpensive Oxygen Retort

By John Phin

OXYGEN is sometimes prepared by heating chlorate of potash and some inert substance in a glass flask or even in a large test tube, but glass vessels are so easily broken that metal retorts are usually preferred. The retorts offered by the makers of chemical apparatus are quite expensive, but one equally as good may be had for a trifling sum from any plumber or gas fitter. The one fuse is simply a piece of gas pipe 15 inches long and 1½ inches in diameter. One end is closed by screwing on a common cap such as is used by gas fitters, and the other end is squared up and the inside reamed out smooth and slightly conical, so that a good sound cork may be used to close it. Through this cork is passed a glass or iron tube on which is slipped the rubber tubing used for delivery. With a good cork and reasonably tight-fitting joints both for the 1½-inch tube and the smaller tube, this retort will sustain considderable pressure without loss. It may be heated in a common stove by holding the corked end in the hand. Two ounces of chlorate of potash with an equal bulk of black oxide of manganese or even clean, fine sand will produce four gallons of oxygen.

Extracting a Lion's Tooth

TOOTHACHE seems to be a concomitant of civilization. Civilized people with perfect teeth are comparatively scarce. Uncivilized and even semi-civilized people give their teeth no care, and yet they remain white and sound; but let such people move to a civilized land, and dental troubles will be sure to develop. The Bulgarian peasant knows neither toothbrush nor toothache, while his fellow townsmen suffer greatly from caries. The same seems to be true even of wild animals. When, as captives, they are brought into touch with civilization their teeth not infrequently yield to our highly civilized disease, and the surgeon of the zoo is obliged to operate upon them. As may well be imagined, his task is no simple one in the case of large ferocious animals. The accompanying photograph illustrates such an operation recently performed at the White City Jungle, London, by Dr. Watt, a West London veterinary surgeon. The patient was a lion cub, fourteen months old, which had been suffering with toothache for some time. He was drawn up against the bars of his cage and held firmly with ropes; then his mouth was kept open with chunks of wood while the surgeon drew the decayed molar. The tooth may be seen in the surgeon's pliers at the right of the picture.

Moving a House by Boat

A CHICAGO real estate dealer recently bought a two-story colonial house on East End Avenue, Chicago. In that location the investment did not appear to be gilt-edged, but the dealer knew that the same house, located in another section of the city, would find a ready sale at a greatly appreciated price.

To move it in the ordinary way on land to that other district would have entailed expense so great as to wipe out the profit he hoped to make. So he decided to move the house by water. Set upon the ordinary skids, the house was hauled to the shore of Lake Michigan. In order to get the house upon the barges and scows on which it was to be towed along the lake shore, it was necessary to build a pontoon, and this operation had to be repeated when the house hove-to off the site of its new location.

Two large scows were lashed together and moored close inshore. Anchored fore and aft and snubbed up on the shore, the scows were held firmly in place, and then guyed by heavy hawsers, the house was skidded upon the scows.

A dozen "husky" stevedores warped the combination offshore, a tug hitched a hawser to the scows, and one hour later the house was snubbed up against the shore twenty-four blocks south of the starting point.

In less than forty-eight hours time all told the house was reposing on new foundations at Lake Avenue. The entire distance, by land, was more than three miles. Fortunately there were no squalls or other weather disturbances to interfere with the work.

Phonographs for Aviation Scouts

ACCORDING to experiments made at the Buc aeroplane grounds, near Paris, it is no longer necessary when scouting to carry a second man acting as observer. The pilot can make all the records of the flight by speaking into a specially arranged phonograph. This was tried with good success on a Farman aeroplane piloted by Capt. Barès, who was accompanied by M. Jules Richard, the inventor of the new "Roneophone," as it is called. In ordinary cases the pilot, when alone, is not able to note down all that he sees, for even should he be able to write, he must then cease to observe. With the new phonograph this drawback is overcome, and without ceasing to steer, he dictates his observations into a speaking tube. This connects with the phonograph so as to make the record. The record is made on a disk, which when filled may be put into a box and dropped from the aeroplane at any point, while a fresh disk is used for another record. It appears that the noise of the motor does not prevent making a good record of the voice upon the disk. During the flight, M. Richard noted all the interesting points on the ground by speaking into the apparatus, and afterward when alighting the record could be very well heard. All the aeroplane officers of the Buc grounds were impressed with the results.

Readers are invited to contribute photographs of novel and curious objects, unique occurrences and ingenious contrivances. Such as are found available will be paid for promptly.

By courtesy of the Sphere.

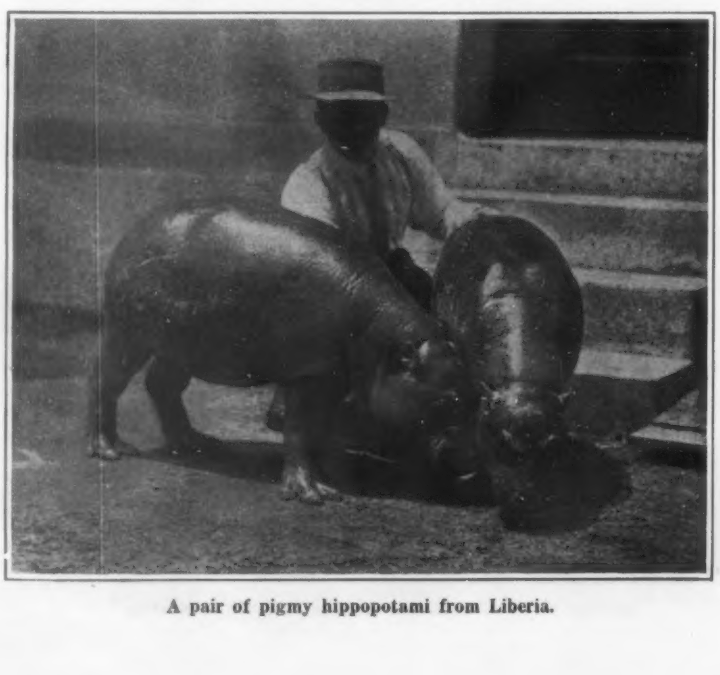
Extracting a lion's tooth.

By courtesy of Flight.

Putting the helmet to test.

Moving a house by boat.

Scout aviator making phonograph records and dropping them to the ground for reproduction.



A pair of pigmy hippopotami from Liberia.

Safety Helmet for Aviators

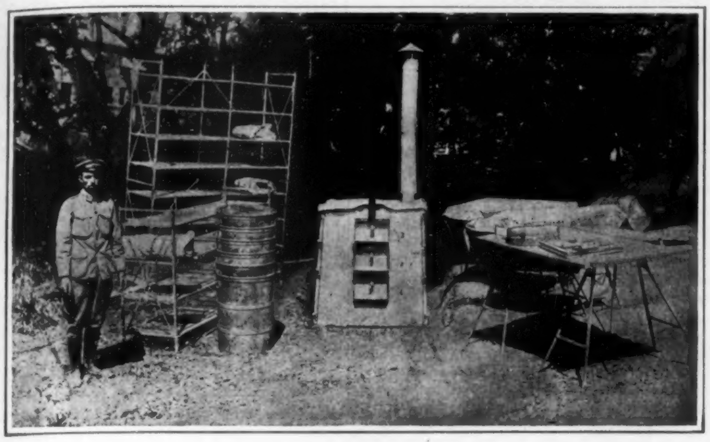
ONE of the pupils of an aviation school in England has recently devised a headgear which is adapted to protect the wearer from shocks or blows. A writer in *Flight*, our English contemporary, from which the accompanying illustration has been culled, states that he had the pleasure of belaboring the inventor over the head with a piece of scantling while he stood passively smiling, without feeling the blow in the least. Then, in order to test the device, it was suggested that the inventor take a running leap full tilt at one of the hangars. This he did, as the photograph shows, and without injury to himself. The headgear is of leather well padded with horsehair and contains a system of flat steel springs, which have the effect of distributing the shock sustained by them over a large area.

First Pigmy Hippopotami in Captivity

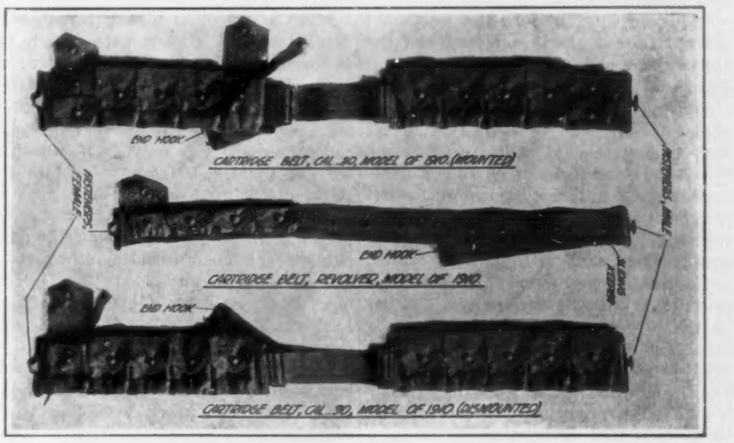
THE New York Zoological Society has just secured some of the rarest animals of the African fauna, a unique pair of pigmy hippopotami from the interior of Liberia.

Though first discovered sixty-eight years ago by Dr. S. J. Morton, of the Philadelphia Academy of Sciences, they have remained practically unknown, as no hunter or explorer has hitherto succeeded in capturing one alive. The two shown in the accompanying illustration are the first living specimens to be exhibited in civilization.

The animals were obtained from Mr. Carl Hagenbeck of Hamburg, and cost $12,000. A special expedition was equipped for their capture in charge of Maj. Hans Schomburgk, an intrepid hunter and explorer. With a caravan of 100 men he penetrated the dense and roadless Liberian forests 200 miles or more from the coast. After many months of dangers, hardships and continual hunting the pigmy hippopotami were located on the upper Lofa River. Here in their remote haunts about 100 pits were dug in various places to trap the animals. The pits were seven feet deep, and were carefully covered so that the sharpest eye could not detect any signs of danger. In these the pair of dwarf hippopotami, male and female, were caught. Maj. Schomburgk states that unlike their big cousins, the pigmy hippopotami do not frequent the rivers. They make their home deep in the inhospitable forest, in the dense vegetation, on the banks of the small forest streams; but, not satisfied with the protection the forest affords them, they enlarge the hollows which the water has washed out under the banks, and in these tunnels, where they are invisible from the bank, they sleep during the heat of the day. It is very hard to even find a place where there is the slightest chance of catching one, because this animal roams through the forest like an elephant or a pig, usually going singly, though sometimes in pairs, and rarely using the same track twice. The legs of the pigmy hippopotamus are longer and more slender in proportion than those of the larger species, and its eyes do not "pop" out of its head. Another striking character is the long tail, twelve inches in the adult male, which in proportion is about twice as long as that of its giant living relative. The face of the pigmy is relatively smaller, which brings the eyes nearer to the median line of the skull. The two hippopotami pictured are about 3½ years old, stand less than two feet high and weigh nearly 200 pounds each.



*The Buzzicott cook stove.



Variations of the Mills army belt.

Inventors and the Army and Navy

The Government's Attitude Toward Inventions on Paper

By William Atherton Du Puy

AMONG inventors there has grown up a pretty general conviction that in the military branches of the Government, the Army and the Navy, there is much discrimination in favor of the men who are in those services as against the independent worker. They hold that the man on the outside who invents anything new in the way of ordnance, projectiles, armor or what not, has a much less chance of selling his patents to the Government than does the inventor of the same things who is in the service.

There is some basis for these charges. It is true, in the first place, that the Army and Navy departments habitually refuse even to consider inventions that are offered by outsiders and that there may be such ideas as would be of much value to those services. These departments do, as a matter of fact, refuse to examine practically all patented articles that are merely on paper. Any important article to be purchased by the War Department or the Navy Department must first have its utility very thoroughly demonstrated. It must be tried in actual operation. If it is a gun that is supposed to shoot five miles, the gun must be actually made and its ability to carry the given distance must be demonstrated in the field. If it is a powder that is intended to drive a given projectile through a given thickness of armor, the powder must be manufactured and shown actually to accomplish what is claimed for it. If it is a tent that is intended to resist certain weather conditions and wear for a certain number of years, the time necessary to demonstrate those points will be taken by the Government.

The man in the service knows these things. When he makes an invention that he wishes to sell to the Government he never goes before the proper authority with mere sketches of his article. He has it in the completed form and has made every arrangement to demonstrate it in actual operation. On the other hand, the civilian inventor goes to the department with the mere plans for an invention. He is not in a position to make a proposition to the department upon the basis on which it does business. He is not given any consideration. He feels he has been discriminated against. As a matter of fact, he has failed of an ample hearing because he is not prepared effectually to demonstrate his article.

Aside from this, the department is constantly working from the inside to improve its ordnance. The Government does not, however, patent its inventions in advance of their demonstration. At the time the outside inventor lays his patent before the department it may be that the same problems are being worked out. If an inventor offered an aeroplane gun to the Government to-day it would be more than likely that some of his ideas would be in conflict with some that are just now being worked out in the Government gun factories, for the Government is very busy along these lines. Unless this inventor had his gun completed and was ready to demonstrate it (an improbable condition) he would be given little consideration. Later the same ideas might appear and he would believe they had been stolen from him, while, as a matter of fact, they had been merely called out by the needs of the time.

The man who is in the Army or Navy quite naturally knows a great deal more of the needs of those services than does the man on the outside. This makes it more probable that he will make inventions for which there is an active demand. When this advantage is added to his knowledge of the particular manner in which such inventions must be presented, it is not surprising that the civilian finds that the inside man is getting the call on the majority of the improved devices.

Again, it may happen that an outside inventor may demonstrate an article which is greatly needed by the Government. He may present his case to the general satisfaction of the given department. That department may want to buy his invention. There is, however, no money available for the purpose. There may be years of delay in getting from Congress the needed money. The man in the Government service is accustomed to deal with governmental delay and red tape. The man on the outside is prone to think that he is being trifled with, to become disgusted with the delay, and to cease diplomatic relations. Here again the fault is not in a discrimination against him but in his lack of an understanding of the exigencies of dealing with so cumbersome a customer as the Government.

If the outside inventor finds that the Government is infringing his patents, here again are conditions which convince him that the Government is attempting to do him an injustice. The Government long had the right to seize, under the law, whatever it chose in the way of an invention and make use of it. The Government might not be sued and there was no chance of getting results through the Court of Claims. The Government maintained that it was favoring the inventor in protecting him from his rivals and that there was little reason why it should grant this protection to its own loss. Until quite recently it has therefore not been unusual for the Government to freely help itself to whatever it chose in the way of patents.

Many inventors have succeeded in getting pay for their patents by means of special bills through Congress. The Government moves slowly in the payment of any claims. Its officials are very conservative in the expenditure of money. They do not pay claims as long as there is any other action they may take. These officials thus assure themselves against any possibility of being held responsible for expending money when such action was not justified. Many an inventor has gone hungry while waiting for the money on a perfectly good claim that rested in some Treasury Department pigeonhole.

The Government three years ago came to the conclusion that it was making a mistake in not allowing whoever made an invention which it used to profit thereby. It got the idea that if patents for appliances were paid for, the development of patents helpful to the Government would be encouraged. A law was consequently framed by the Commissioner two years ago and it finally passed. To-day there is a chance of sale of a patent to the Government that is comparable with the chance of sale to any other large business concern, and the Government now protects the recipient of a patent from Federal infringement as well as infringement by private individuals.

But conditions have long been such as to lead the inventor to believe that there is a conspiracy to keep him out of governmental recognition and from realizing upon his inventions. The facts probably are that he is merely up against a condition that exists in the departments and that there is no favor whatever shown to the inside man. He must learn the method in which patented articles must be presented to the Government and he must satisfy himself with the deliberate manner in which the Government settles perfectly good claims.

When the civilian fails to sell a patent to the Army or the Navy and he feels that he has been done an injustice, he freely voices his discontent. The public hears more or less of this dissatisfaction. Just the opposite is true of the man in the service. When he fails to get his invention accepted he may protest in his inner circle but there is little heard on the outside. This is because of a very peculiar and interesting condition with reference to inventions that exist in the Army and Navy and because of which the service inventor is at heart more bitter, in many cases, than is the man on the outside.

Almost from the beginning of the Government it has been a matter of sentiment and of more or less general practice that the man in the service making an invention should not consider it as his own but as something accruing to the service with which he is associated. There is a departmental order to this effect in the Department of Agriculture. In the War Department and in the Navy Department this rule has been enforced. There is no departmental regulation which places any stress upon the inventor or in any way makes it necessary that he should donate his invention to the Government.

The legal aspect of the matter has been definitely settled. The decision of the Supreme Court of the United States in the case of the United States v. Burns defines the rights of any officer or employee of the Government in his patented invention. That decision is, in part, as follows:

"If an officer in the military service, not specially employed to make experiments with a view to suggest improvements, devise a new and valuable improvement in arms, tents, or any other kind of war material, he is entitled to the benefit of it and to letters patent for the improvement, from the United States, equally with any other citizen not engaged in such service; and the Government cannot after the patent is issued make use of the improvement any more than a private individual without license of the inventor or making compensation to him."

But despite all this there is a general prejudice against the man of the Army or Navy making any money out of inventions. It is held that these men have been given their technical education by the Government and that they have drawn salaries from the Government during the time they have been evolving these inventions. Therefore the inventions should be the property of the Government. The public is inclined to this belief. The majority of the men in the service either favor this construction of their duty or yield to public opinion. It is true that great numbers of very valuable inventions are thus given these services every year.

On the other hand, the Government has repeatedly paid for the inventions of its officers. The occasions are too numerous to mention, but reference may be made to a few. There is, for example, the Mills Woven Cartridge Belt, the Dashiell Breech Mechanism, the Fiske Telescopic Sight, the Lewis Range Finder, the Driggs-Schroeder Gun, the Fletcher Breech Mechanism, the Sibley Tent, and a great many others. The list of Army and Navy officers that have been pecuniarily benefited by their patented inventions would be almost endless.

Probably the greatest success among the Army inventors has been Brigadier-General Anson Mills who has made a large fortune through the cartridge belt that he called into being. When Gen. Mills was doing scout work in the West many years ago he was greatly annoyed by the fact that the army belts were constantly coming unsewed and failing to serve the purpose for which they were intended. He devised the one-piece woven belt that is now in use. When he had completed his belt he offered it to the Army through the proper channels but it met with no favor. He wanted to sell it abroad and sought a manufacturer for it. There was no machinery

that would weave it. He then invented a weaving machine to make this particular product. He took the machine and the belt abroad and sold them to different European governments. Thus encouraged he returned to America and finally succeeded in selling to the War Department and, having been at first turned down, forced the Government to pay him a handsome price. It is not known just what his royalties have been, but the figures of business in this belt done in a single decade show that more than a million and a half dollars' worth of them were used. Gen. Mills is now retired, and out of the proceeds of his belt has built a large and handsome office building just across the street from the War Department, and this he rents to the Government, and it accommodates overflow bureaus from that department.

The Sibley tent is an invention that has drawn a lot of money from the War Department. H. H. Sibley patented it in the late fifties and entered into partnership with Maj. William W. Burns, and these gentlemen sold tents to the Government, receiving $10 each on the first fifty and $5 each on 3,600 that immediately followed. When the Civil War broke out Sibley identified himself with the Confederacy, and thereafter he received no royalties. Maj. Burns remained loyal and continued to receive his proportion of the royalties which aggregated something like $120,000.

Maj. O. M. Lissak, U. S. Army, is the inventor of a machine for the manufacture of cartridge clips. This machine has been in use in the Government arsenals for many years, and it is claimed that it saves the Government some $40,000 a year. The Government entered into no contract with Lissak for its use, and he had derived no benefit from his invention until, in 1905, a bill was introduced into Congress awarding him a lump sum of $25,000.

Francis H. Buzzicott was a private in the army and assigned to the mess squad. In connection with his work in the field he devised a range for baking bread. These ranges were remarkable for the amount of bread they would produce in a given space and for their lightness of weight. They immediately found favor in the Army. Altogether nearly $200,000 worth of them has been bought by the Army. They are manufactured by a company to whom Buzzicott assigned his patents, and the amount of his royalties is unknown.

Capt. Thomas Franklin, U. S. Army, has made a more typical invention. He worked out a potato-peeling machine, the manager of the laundry at West Point collaborating with him. They assigned their patents to a manufacturing company in New York, and to date there have been some hundreds of these machines sold to the Government at $250 each, out of which it is reasonable to suppose the inventors have received a fair royalty, and the end is not yet.

Lieut. H. C. Mustin, U. S. Navy, is the inventor of a telescopic ordnance sight which is used in the Navy. The owners receive, through an agreement authorized by the Secretary, $50 each on these sights purchased by the Navy. The first purchase was sixty-six sights, which netted the inventor the neat sum of $3,300.

Philip Hichborn, Chief Constructor of the Navy, retired, is the inventor of the Franklin life buoy, a circular float with a patent torch that flares up when the apparatus hits the water. The inventor received $50 for each buoy during the life of the patent, and since the seventeen years allowed him because of his protection expired, he has been receiving $25 each royalty, as a result of which he has become a very wealthy man.

J. A. Mudd, Pay Inspector of the Navy, invented a carrier for pneumatic tubes, which he sold for $1,200; Commander William Little of the Navy, a boiler tube stopper, which is now in use in every ship of the Navy. He has never received any money for it, but maintains that the Government should pay him one dollar for every stopper it is using. George F. Schild, a naval architect, invented at Mare Island a caisson gate, which the Government built into a drydock at an expense of $60,000, thereby saving itself $40,000. Schild sued the Government, but there was no way in law that he could collect, as this was previous to the passage of the legislation that enables the Court of Claims to award inventors. L. G. Billings, a Pay Director in the Navy, patented an emergency food, selling his patents for $500 in cash and two cents a can on all that was sold. The Government has been using adaptations of this food ever since. So might the list be continued indefinitely.

The man in the service is, therefore, embarrassed by a semi-established custom of dedicating his patents. If he is not treated as he feels he should be when he offers his patents for sale he rarely makes much public clamor in the matter. It is, therefore, taken that he is well satisfied with the treatment he receives from the Government, and his silence, when contrasted with the clamor of the civilian, is taken as an indication of a different treatment accorded him. With all the facts in mind it would seem probable that the inside man in the War or Navy Departments has a much less chance of profiting by his inventions, particularly if they were presented with no better understanding of the particular needs of the case, than has the civilian.

It is unquestionably true that both the War Department and the Navy Department are vigilantly on the lookout for any invention that will improve any one of the thousands of things that go to make up the equipment of either of those services. Particularly since the passage of the law of two years ago is there an excellent opportunity to sell to these departments patents that may be demonstrated in such a way as to show the advisability of their purchase. A survey of the whole situation would lead to the conclusion that either civilian or service man has an excellent chance of getting some of this Federal money if he but knows the advisable method of placing his invention before the department, and if he but accepts philosophically delays that are sure to come and bides the time of ultimate settlement.

Notes for Inventors

A Non-renewable Incandescent Lamp.—In patent No. 1,034,722, to General Electric Company, assignee of M. M. Merritt of Middleton, Mass., is shown a non-renewable incandescent lamp in which a filament is arranged in a bulb and means are provided for defacing the walls of the lamp space when the lamp is violently heated.

Combines Coffee Pot and Tea Pot.—In a body of conical form a partition is arranged to provide two compartments, one for tea and the other for coffee. The compartments have individual spouts, each with a valve, and they also have separate lids or covers, and either or both of the compartments may be used as desired. The patent, No. 1,035,407, was issued to James R. Beaseley of Lynchburg, Va.

Novel Disposition of Aeroplane Planes.—Dickran G. Terzian of Washington, D. C., has received patent No. 1,035,660 which shows an aeroplane with a frame and front and rear pairs of upper and lower sustaining planes, with the planes of each pair extending in opposite directions and lapping at their inner ends. The upper plane of each pair is at the same side of the frame as the lower plane of the other pair.

A Baltimore Heater.—In a patent, No. 1,034,465, to James M. Kennedy and James O'Hara of Baltimore, Md., there is shown on the sloping roof of a house a solar water heater, in which a glass covered box contains a number of thin flat hollow metal sections connected to form practically a coil and exposing their flat faces to the rays of the sun, supply and delivery pipes being supplied to circulate water through the heater.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12680) C. C. asks: In a heavy storm how far below the surface of the ocean will the wind have an effect on the water? About how much of the surface does the wind drift, or how far below the surface will an object have to be that a storm will not affect it? A. There are instances on record in which the effects of the waves of a great tempest have been known to reach about three-quarters of a mile below the surface of the water. Telegraph cables have been disturbed at that depth in the Wyville Thomson Sill, a depression in the ridge which separates the basin of the Atlantic Ocean from that of the Norwegian Sea. Of course, the effect of the wind upon the water varies so much under different circumstances that no simple rule can be given which will cover all cases, and generally the depth to which an ordinary storm disturbs the water is not great. Probably stone work will not be overturned below a depth of 40 feet, though perceptible motion of the water may be detected to about 350 times the height of the wave, as is shown by experiments in the laboratory. We have no figures for the drift of the surface in a wind. Where there are no currents, it would not be very far.

(12681) U. S. W. asks: I once participated in an experiment where four persons lifted from the floor on which they stood a fifth person, weighing 135 pounds, upon the tips of their index fingers. I being one of the four, remember very distinctly that the party whom we raised from the floor apparently did not weigh one pound ,but rather seemed to be sustained by some unseen force; while to the party who was being lifted, according to his own statement, the word *weight* had (for the time being) lost its meaning. He stated his body seemed to be unaffected by gravity. Would you kindly refer me to some work treating on the subject? A. We do not know any book in which the experiment of lifting a person in the manner you describe is explained. We are called upon very frequently to explain it, and will give you our explanation: Four persons lift a person weighing 135 pounds. Each one of the four lifts about 34 pounds. That in itself does not call for any great effort, even when done by the index finger alone. The writer has lifted 150 pounds with his little finger. When you lifted the 34 pounds, you were all required to do something else at the same time, were you not? Usually the one directing the experiment requires that all, including the person to be lifted, inhale the breath forcibly and absolutely at the same instant, and to lift at exactly the instant at which they breathe. The natural result of concentrating the mind and all the mind and attention upon breathing, is that every one is totally oblivious to the amount of effort put forth as lifting. You think you do not lift at all, but in fact you lift one-fourth of the weight of a person. Try it on something which four people cannot lift with their index fingers, and you will find that gravity has not been suspended. The explanation is psychological.

(12682) S. G. M. asks: I shall be greatly obliged if you will kindly decide the following dispute. I claim that time has always existed, while my friend maintains that time began when the world began. Which is right? A. "Time" is usually defined, "a measured portion of duration." It is from the Latin, *tempus*, *temporis*, from which we get our words *temporary*, *temporal*, and others. One derivation of the word is from the Latin verb *tendere*, *tensum* or *tentum*, which means to stretch out or cover over. From this verb we have *tense* in grammar, the time to which an action is limited; *tent*, a cloth stretched over one for a cover, and many others. Duration has no limit. It is endless. From its derivation time must have limits, a beginning and an end. All our words for periods of time express this thought: a second, a minute, hour, day, year, century, etc. Eternity expresses limitless time, but usually in one direction only. In common speech we say there has been an eternity past in which time began. There will be an eternity to come in which time will end. When time began, and when it will end, we do not know. We can, as we do, begin the measuring of time from any event—the year 1912 of the Christian era, or the year of the world, if we knew its number, but this is an arbitrary method of reckoning. There is no natural unit of time. The best one we have is the day, and that is variable, the astronomers tell us. You see we cannot agree with either of you. We do not think time has always existed. Creation was at the beginning of time; but that was before the world was evolved from the original nebula. All our chronologies are of our own invention; useful for our own purposes, but not natural, and at some time to come to an end. Do you say, "This is more logical and theological than scientific?" Well, perhaps. We do not decide which of you two friends is wrong, if either is, or assert that we are wholly right. In many things much depends upon the definition, the limit from which you set out in determining the terminus to which you come.

Grenadiers of the Air

(Concluded from page 215.)

believe the statement published in Germany on August 15th, as coming from a "really reliable source," an engineer there has succeeded in constructing an aeroplane, which by an ingenious mechanism can remain suspended for a considerable time in midair. Before accepting the announcement we must wait. Still, sights to meet such a case as this have been thought out, one such being an arrangement of mirrors for use at night when attacking warships at sea. The aerial destroyer is supposed to be maneuvered above a vessel until the glare from her funnels is seen reflected in the mirrors, when the pressure of a button causes a dynamite bomb to drop vertically onto the target.

These plans are excellent no doubt as far as they go, but they leave out of consideration the fact that the noise of the engine on a calm, still night would very probably betray the approach of the aircraft, if an aeroplane—the insistent rattling hum of M. Salmet's machine along the coast line of the Isle of Thanet is in my ears as I write; and to silence the engine may involve loss of power at a critical time.

Again, although we have no actual experience on the effect of the bomb-dropper's flying machine of the explosion of a heavy charge of, say, dynamite on the ground-surface vertically beneath, it may be assumed that he would be safer at some distance in a diagonal direction from the point of impact, so as to be clear of the *upward* effect of the explosion which must cause a considerable disturbance of the air in its neighborhood by concussion. It would be better therefore on this supposition that the bomb should be delivered while the flying machine is on the move, and to meet this condition the best apparatus which has yet been tried on occasions open to the public and of which records are available for publication, is the one which scored a victory for the United States in the person of Lieut. Scott this year in the Michelin Target Competitions, for bomb-throwing from aeroplanes, in France. These, after being open for a considerable time, finished in the middle of August and the American officer, in a monoplane piloted by the French aviator, M. Gaubert, succeeded in winning the $1,000 Michelin prize for dropping fifteen bombs into a circle 66 feet in diameter from a height of 656 feet by placing twelve out of the required fifteen projectiles within the area of the target. He had previously made an almost equally good record by dropping eleven out of fifteen into the circle. Also in the previous week he had won the prize of $5,000 for dropping the largest number of bombs into a rectangular space of 170 by 40 feet from a height of 2,400 feet.

These results are quoted from the Paris correspondent of an English daily paper. Without having been actually present at the competitions it is impossible to judge how far the conditions approached those of war, except as regards the height of drop, but Lieut. Scott's apparatus has been described in the SCIENTIFIC AMERICAN of October 28th, 1911 and the British *Aero* for March, 1912. Although, like any other mechanism of a similar kind, it must require perfect co-operation, as the result of practice, between pilot and bomb-thrower, it is far and away the best and most practical which has yet been heard of. The German authorities have carried out careful experiments from time to time and are understood to have satisfied themselves that the dirigible forms a better carrier and platform for the bomb-dropper than the aeroplane. The firm of Zeiss, the well-known opticians of Jena, have brought out a sighting instrument, but the particulars of this, like those of the German experiments, are kept secret at present.

It is significant that the various large dirigibles which are being built to contract for the French and German governments are all designed to carry considerably more weight than is required for engine, crew, fuel and oil, the presumption being that a margin is allowed for explosives. In some cases it is specifically stated that special

apparatus is to be carried for dealing with explosive projectiles. We may therefore assume that bomb-dropping is considered as a serious proposition by those nations who are most likely to have occasion to practise it.

A single aeroplane may be a negligible quantity as an engine of destruction, but a fleet of a hundred or so machines, working in sections, well organized, with carefully trained pilots and bomb-droppers and systematic methods of ammunition-supply, may be a very formidable instrument in the hands of a capable commander.

It must be remembered that a regular bombardment is a singularly inefficient method of getting results; as a man-killing projectile the dropped bomb will probably be of inferior value, and the expenditure of time and energy required to fly to the scene of action, with the small number of projectiles which can be carried at present, and return at intervals for fresh supplies will be very exhausting to the airmen, and cause considerable wear and tear of the machines. The trained pilot and his aeroplane form between them a unit which for some time to come will be too valuable for purposes of reconnaissance to be employed for bomb-dropping, unless under very exceptional circumstances.

Such circumstances might well be considered to exist where the destruction of a specific nerve-center in an enemy's country could be accomplished by no other means and might cripple his organization and have far-reaching consequences, or in naval warfare when the location of a mine or of a submarine from overhead and its destruction could only be accomplished by aircraft. In the latter case the clever naval airman will probably be able to bring his hydro-aeroplane close above the submarine, drop a charge of explosive, arranged to act under water, and be well out of reach of the concussion before the explosion takes place.

To the impartial observer with an open mind and some military experience the question of dropping projectiles from aircraft is a difficult one at the best, and by the light of such information as is available at present it would be extremely unsafe to dogmatize—the data are insufficient. All we can be sure of is, that there are great latent possibilities of aggressive action.

The Gnome Rotary Engine

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valves in the Gnome engine are removed with the greatest ease, special socket wrenches being supplied for the purpose.

One is prepared for the construction wherein the cylinder is cut from a solid bar of steel, but one is genuinely surprised to learn that the crank case is also cut from a solid drop forging. In the rough, this forging weighs no less than one hundred and six pounds, which weight is reduced in the finished crank case to thirteen and one half pounds. Starting with one hundred and six pounds, no less than ninety-two and one half pounds of steel shavings are produced in the manufacture of a thirteen and one half pound crank case. Now, perhaps one appreciates why I said that the Gnome factory was literally turning out steel shavings.

Fig. 8 pictures the finishing of the hollow crank shaft. Upon this crank shaft there is one master connecting rod to which are attached six auxiliary connecting rods for the rest of the seven cylinders. Annular ball bearings are used on both the main bearings, for the thrust bearing to take the thrust of the propeller, and on the large end of the master connecting rod. The large ends of the auxiliary connecting rods and the small ends of all the rods have plain bearings. In operation, the Gnome motor is ignited by a Bosch high-tension magneto. The castor oil, which is used as a lubricant, and the gasoline, are fed by a positive acting piston pump to the hollow crank shaft. The lubricant and fuel then pass through the automatic inlet valve in the head of the cylinder. The inlet valve is most ingeniously weighted by counterweights to compensate for the action of centrifugal force.

Figs. 9 and 10 give a good idea of the method of testing employed at the Gnome factory. The finished motor, together with its fuel and oil tanks, is mounted upon a sort of gun carriage, and in place of a propeller a crude paddle type of dynamometer is fitted as shown in Fig. 9. Careful tests are made in this manner before the finished engine is allowed to leave the factory.

Much has been said regarding the so-called gyroscopic force developed by the rotary engine. To show that this is negligible, Monsieur Seguin took me into the testing room, ran a 70 horse-power motor up to thirteen hundred revolutions per minute, and lifting the tail of the gun carriage (the whole is nicely balanced about the wheels), handed it to me so that I could change the plane of rotation of the rapidly revolving mass. This I did, and unless I made a very rapid movement, much more rapid by the way than a sane aviator would make in flying, the gyroscopic effect was almost unnoticeable. And let me take this occasion to remark that in all of my flights with my 70 horse-power Gnome-driven Blériot monoplane—and I have made in all one hundred and seven flights in the machine—I have never had to allow in the manipulation of my controls for the gyroscopic force, much talked of among "rocking chair aviators." Of course it exists, but I account for the fact that it is negligible in actual practice in that the plane of rotation of the motor is not changed rapidly enough to produce a noticeable gyroscopic effect.

Now as to the future. As far as I can see from a more or less thorough acquaintance with both the rotary and the stationary aeroplane engine, the rotary motor will be the better for speed work and where the greatest possible load is to be carried. When several disadvantages of the rotary are overcome I think it will be the better motor for all classes of aeroplane work. In other words, I think a motor of the Gnome type will always be the lightest for the power developed. In this connection let me say that there is an opinion prevalent among aviators acquainted with both types that 50 horse-power from a rotary engine accomplished more in an aeroplane than 50 horse-power from an engine having stationary cylinders. This has been my experience, and I account for the difference in the superior flywheel effect in a rotary engine which is itself an unusually effective flywheel.

Summing up its disadvantages, the rotary motor of to-day is expensive to buy, very expensive in upkeep, and will not stand the rough usage which would have little effect upon the more orthodox engines having stationary cylinders. These disadvantages may be and probably will be overcome in the future, and then we shall have in the rotary gasoline engine the nearest thing to the ideal aeroplane motor.

Monsieur Seguin told me, when he showed me through his factory, that he was working on a two-cycle engine, and that he expected to realize one hundred and twenty horse-power with less weight than in my seventy. If a practical two-cycle rotary motor were evolved, it would be only one step removed from the motor which will undoubtedly be the aero engine of the future—the long-sought-for and much-talked-of gasoline turbine; and as an aviator who appreciates the great advantages of an ultra light but powerful motor, I hope to live to sit behind such an engine.

In America we have neglected the rotary type of aeroplane engine mainly for two reasons. First, it is very expensive to build and few factories have the shop equipment necessary to its successful construction. Second, it is not an easy motor to design. We are thoroughly acquainted with the engine having stationary cylinders from our automobile practice, but in the design of a rotary motor we enter a new and comparatively unexplored region. Several rotary engines are now being made in this country, and soon, no doubt, a thoroughly tested and reliable rotary engine aeroplane motor of Ameri-

can manufacture will be available. Realizing as I do, from practical experience in the air, the great advantage of the rotary aeroplane motor, I feel confident that it is the aero motor of the future, and I strongly advise American manufacturers, who have so far chosen to ignore it as a freak, to give the matter their earliest and careful consideration. The rotary motor has made remarkable headway against almost universal opposition until to-day the world's speed records, without a single exception, are held by a motor of this type.

The Race for the Harmsworth Cup

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first circuit two seconds in the lead, making an average of forty-six miles an hour, the fastest ever accomplished by a motor boat in competition. "Maple Leaf IV" was thirty-two seconds behind.

At the finish of the second lap "Ankle Deep" led, followed by "Reliance II," two hundred and twenty yards ahead of the English boat. In the race to the outer turn for the third time "Ankle Deep" still led, but "Reliance II" had to stop before the turn was reached. The "Mona" burned out a bearing and had to give up. The contest lay between "Ankle Deep" and the other British boat, with the former three quarters of a mile to the good. "Ankle Deep" was visibly running away from "Maple Leaf IV," when suddenly it was seen that "Ankle Deep" had stopped and was gyrating. A few seconds more and it was all over. "Maple Leaf IV" came home an easy winner.

"Reliance II" had blown out two of her cylinders. When "Ankle Deep" was going forty-five miles an hour Count Mankowsky attempted to make too sharp a turn at the westerly mark. Her starboard propeller, strut and rudder were literally wrung from the hull into a twisted, shapeless mass. The "Maple Leaf IV," running as smoothly as a watch, covered the course in forty-seven minutes and forty-six seconds, or at an average speed of 43.125 miles per hour, rather better than "Baby Reliance II" did in the first race, but considerably less than the burst of speed shown by the same boat in the first circuit, and behind the rate at which "Ankle Deep" was speeding when she met with her mishap.

Everyone conceded that, barring accidents, the "Ankle Deep" was the fastest boat. It was also equally evident that the winning English boat was by far the most reliable of the five contestants. Reliability won the race and not speed.

This question of reliability did not lie wholly with the engines. From the point of view of mechanical excellence there was little to choose between the various types of motors used on the five boats. Under similar ordinary conditions there is every reason to believe that one would prove as reliable as another. The fault was not that the "Ankle Deep" or the "Reliances'" engines were not as good as the "Maple Leaf IV's," but that they were not as well installed. Impartial critics of the boats are of the opinion that had the installation of the motors been more thoroughly looked after the result would have been different. It is said, for instance, that one of the "Ankle Deep's" shafts was out of alignment and that this was known before she started, but that the defect was not considered of sufficient consequence to attempt to remedy in the short time that was available. It was also stated that the loss of the "Ankle Deep's" propeller, which cost America the race, was partly due to the use of too light bronze in her propeller shafts. At any rate, the sudden strain, added to the deviation from alignment, was too much for the metal, and it gave way. To sum up the mechanical side of the matter, the British boat was looked after more thoroughly, more carefully groomed, than any of the American craft.

Of course, so long as there are racing motor boats, each of the varying niceties of construction, shape of the hull, number of steps, and so on will have its advocates. There is little question, however, that the design of the "Ankle Deep" and of the "Reliance" boats is superior to that

of either of the British craft. Therefore, in building the three new challengers, one of which it is hoped will lift the Harmsworth trophy next year, it is not likely that any wide departures will be made from the outlines that have been found so satisfactory.

One other essential lesson has been taught to the American builders by this race. It has been demonstrated that boats under thirty feet in length—the limit is forty feet in the Harmsworth deed of gift of the trophy—cannot hope to succeed except under exceptionally perfect conditions of the water. The "Maple Leaf IV" is thirty-nine feet eleven inches long, within one inch of the limit. The "Baby Reliance II" is but twenty feet long, and the "Ankle Deep" thirty-two. The British craft was more seaworthy, built to take both calm and rough water. The American craft, with some exception in favor of the "Ankle Deep," are wonders in the speed line under perfect weather conditions, but when the water grows rough they are almost helpless. This contest proves that America still has the fastest motor boats, but that the English are ahead of us in reliability. The new American challengers will have both speed and steadiness of hulls and engines, essential qualities if we are to recapture the Harmsworth Cup.

Our Enormous Coal Losses

"DURING the last year, in producing half a billion tons of coal we wasted or left underground, in such condition that it probably will not be recovered in the future, a quarter of a billion tons of coal; we turned loose into the atmosphere a quantity of natural gas larger than the total output of artificial gas during the same period in all the towns and cities of the United States; we also wasted or lost in the mining, preparation and treatment of other important metalliferous and non-metalliferous minerals from 10 to 50 per cent of the year's production of such minerals."

The above is the startling manner in which Dr. Joseph A. Holmes, director of the United States Bureau of Mines, describes some of the losses in the yearly production of two billion dollars worth of minerals in the United States.

The words of the director are a general summing up of a statement just issued by the Bureau, in which an inventory of the various mineral wastes are given and in which the Bureau shows how millions and millions of dollars may be saved to the people of this country through the right sort of conservation of its resources.

The general statement, written by Charles L. Parsons, chief mineral chemist of the Bureau, contains the charge that many valuable mineral deposits are lying idle, while the products are being imported from other countries. Mr. Parsons further declares that through wasteful use of certain of the minerals, the ultimate exhaustion and dissipation of some of the important useful minerals of to-day from the standpoint of the race and in the light of present knowledge, is in sight. He urges that many deposits of ores of such low grade that they cannot be mined to-day should be left in position so that they can be mined in the future, as many ores, formerly of too low grade to work with profit, are now sources of wealth. The wastes of the past are daily being converted into the dividends of the present, he declares.

In referring to the waste in the mining and use of coal, Mr. Parsons says, "The wastes of carbon in our modern economy are almost incomprehensible. In mining coal in this country, probably one third of the bituminous coal and one half of the anthracite are left in the mine. Fully 80,000,000 tons of anthracite is now being left behind in the mine each year, and it is estimated that since mining began in this country fully two billion tons of anthracite and three billion tons of bituminous coal have been left in the ground under conditions which make future recovery highly impossible.

"After coal is mined the losses by no means cease, although some of the culm that formerly went to waste by millions

of tons is now being used. Probably not over eleven per cent of the energy in coal is being effectively utilized. The remainder of the energy is lost through the inefficiency of the steam boiler, the steam engine and the electric dynamo.

"It is estimated that the boiler scale in locomotives alone in this country means a loss of over 15,000,000 tons of coal annually. It has been shown that one sixteenth of an inch of scale means a loss of 25 per cent in boiler efficiency. The scientific control of the combustion of coal under boilers is constantly increasing, but the losses of carbon that is still pouring from our chimneys, defacing monuments, buildings and landscape are without valid reason."

Mr. Parsons says that the losses in making of coke by the old-fashioned process wasted $40,000,000 in the United States last year. He calls this an entirely needless and seemingly ruthless loss. He declares that these coke ovens, without taking into account the value of the by-products that were possible, wasted more than one million horse-power in the year. All this loss might be prevented by the use of modern methods, he says.

"The dust from stacks and chimneys of all kinds," says Mr. Parsons, "is often not only a great waste of valuable material, but is one of the great evils of modern civilization. Valuable metalliferous dusts are strewn broadcast from the stacks of our smelters; gases and poisonous solids destroy vegetable and animal life; and masses of black smoke pour from our chimneys and settle in clouds over many of our cities, rendering them exceedingly disagreeable and unsightly. Even with present knowledge, practically all dust nuisances are preventable, and legislation the country over is diminishing the dust output from smelters, cement plants, and from smoking chimneys, often with the result that the collection of dust incident to smoke prevention becomes a source of profit.

"Almost inestimable losses of sulphur, arsenic, and bismuth are now taking place in the flue dusts and flue gases.

"In proportion to output the losses of zinc are probably greater than those of any other metal, and are especially important because there is almost no recovery of zinc from manufactured products and almost no conservation of zinc by accumulation. Besides these losses in the mining and concentration of zinc ores, there are incalculable losses, which without question run into many millions of dollars and undoubtedly exceed the total value of the zinc mined, in slags and waste products from other processes. Zinc has been and in general still is considered about the worst impurity to be found in the ores of copper and lead, for it has always given trouble in their metallurgy.

"In combined, but unfortunately in relatively insoluble form there are unlimited supplies of potash in this country. Because no methods are known for economically obtaining the potash we are obliged to import from Germany about $15,000,000 worth each year. Potash is absolutely essential, and unless methods can be found for obtaining it from domestic supplies, we shall be obliged to purchase it from Germany at a price at least 400 per cent more than the cost of delivery in New York.

"Our waste of nitrogen, worth in combined form about fifteen cents per pound, are almost inconceivable, and no calculation can give us a real idea of what these losses mean. Although we produced last year over 406,000,000 tons of bituminous coal, we recovered only $3,800,000 worth of the $160,000,000 worth of recoverable nitrogen in the coal.

"Of course, it is entirely impracticable under present conditions to recover as ammonia all of the nitrogen that might be obtained, but it does seem most regrettable that of 63,000,000 tons of coal converted into coke in 1910, containing $22,000,000 worth of recoverable nitrogen, only about one sixth was treated in ovens or retorts which could make that recovery possible. The rest of the nitrogen in the

coal went off as free nitrogen in the air. It is estimated that since the first by-product coke oven was built in this country in 1893, and up to the present time, the coke coked in the old-fashioned beehive ovens where the nitrogen was ruthlessly wasted in fire has amounted to about 810,000,000 tons. Had this been coked in by-product ovens the volatile nitrogen of the coal would have yielded twenty-three pounds of ammonium sulphate per ton or a total of 9,315,000 tons, which at $60 a ton would have had a value of $558,900,000. But this would not be all. Had this ammonia been recovered, it would have been used on the soil as a fertilizer and the crops would have increased fully 20 per cent, and the saving would have been many millions more.

"The waste and the utilization of sulphur are both enormous and depend largely on local conditions. We produce sulphur cheaper than any other country in the world, sell it at perhaps the highest price, and in the form of sulphur dioxide discharge it in the air from the stack of a single smelter in quantities almost as large as those utilized throughout the country from sulphur and domestic pyrite put together. If the sulphur discharged into the air from this one smelter were converted into sulphuric acid it would furnish more than enough sulphur acid for the total fertilizer industry of the United States. This country is producing annually about 3,000,000 tons of sulphuric acid—the basis of all chemical industry—of which approximately one half is used in the manufacture of fertilizers. The total amount of sulphur dioxide discharged into the air in the country would unquestionably suffice to make more than 8,000,000 tons of sulphuric acid."

The American Road Congress

THAT not less than $250,000,000 would be saved to the country in the cost of hauling the present record breaking crop if 20 per cent of the public highways of the country were improved, is the assertion of J. E. Pennybacker, Jr., executive secretary of the American Road Congress, which is to be held in Atlantic City September 30th to October 5th. Mr. Pennybacker, before becoming the secretary of the American Association for Highway Improvement, which, with the American Automobile Association and the National Association of Machinery and Material Manufacturers is holding a convention at Atlantic City, was the chief of the Road Management Department in the United States Office of Public Roads, has made a comparative study of the cost of hauling crops over good and bad roads.

In an interview Mr. Pennybacker said that it will be merely a matter of a few years before 20 per cent of the public highways of the United States will have been improved. At the present time little over 8 per cent of the public highways are of the improved type.

"The Governments' prediction that the crop now being harvested will exceed any previous year's yield," said Mr. Pennybacker, "should serve to call attention to the great losses that are being sustained by farmers and consumers in the hauling of crops. It is estimated that the improvement of the main roads of this country, approximately 20 per cent, would result in an annual saving of at least $250,000,000 in the cost of hauling alone, which would be sufficient to improve 50,000 miles of road at a further cost of $5,000 per mile. In five years this would improve 250,000 miles, which would be sufficient to bring the total mileage of improved roads up to 20 per cent.

"There are more than 25,000,000 farm horses and mules in the United States, valued at $2,700,000,000; about 1,500,000 horse-drawn vehicles valued at $83,000,000, and more than 450,000 automobiles valued at about $500,000,000. A depreciation of 5 per cent, caused by the wear and tear of bad roads, would amount to $164,000,000 annually, which at $5,000 per mile would be sufficient to build 32,800 miles of improved roads.

"These are but a few great economic

facts. Once the people realize the great waste involved in bad roads, there will be little delay in the improvement of the main arteries of commerce throughout the country."

The Antiquity of the Raingage

WHEN and where was the raingage invented? The fact that the customary ascription of this invention to Benedetto Castelli, in the year 1639, is far indicating the real antiquity of the instrument was pointed out in the SCIENTIFIC AMERICAN of December 24th, 1910, p. 504. In the same connection it was noted that the great importance of rainfall in its relation to rice-growing led to the construction of raingages in Korea as early as the year 1442 A. D.; while a much earlier use of the instrument—in response to agricultural requirements in Palestine—described in the Mishna, carries the history of raingages back to the first century of the Christian era.

A further contribution to this subject is published in the *Quarterly Journal* of the Royal Meteorological Society for January, 1912. The writer, Jogindra Nath Sammadar, quotes some pertinent information from a book entitled "Arthastra," or "The Science of Politics," written by Chanakya, the famous minister of Chandragupta, the founder of the Maurya dynasty in India, and dating from the fourth century B. C.

In the chapter on the "Superintendent of Agriculture" this early work states:

"The quantity of rain that falls in the country of Jangala is 16 *dronas;* half as much more in Anupanam countries; 13½ *dronas* in the country of Asmakas (Southern India); 23 *dronas* in Avanti (Konkan); and an immense quantity in Apparantam (western countries), the borders of the Himalayas, and the countries where water-channels are made use of in agriculture. When one-third of the requisite quantity of rain falls both during the commencement and closing months of the rainy season, and two-thirds in the middle, then the rainfall is considered very even."

These explicit statements certainly point to the fact that some form of raingage was known in India as early as the fourth century B. C. As to the *drona*, the writer only tells us that it was "a cubic measure;" hence, even if we knew its value, we should need also to know the surface area of the raingage in order to interpret the statistics given above; whereas modern statistics of rainfall, in linear measure, are independent of the dimensions of the gage.

Another passage in the same work seems to indicate that ancient Indian meteorology used a classification of cloud forms much more elaborate than any we have to-day:

"Three are the clouds that continuously rain for seven days; 80 are they that pour minute drops; and 60 are they that appear with the sunshine."

Announcement

WE beg to announce a new department of the SCIENTIFIC AMERICAN, devoted to the interests of present and prospective owners of motor-driven commercial vehicles.

The department will contain:

Discussions of Live Topics.

Real Experiences of Motor Truck Owners, showing how the power vehicle works out in actual practice in various lines of commercial service.

Obstacles overcome and economies effected by the introduction of the gasoline and electric horse.

Up-to-date information on the latest improvements in auto trucks and delivery wagons.

Advice on the care and upkeep of motor vehicles.

In connection with this Department an Information Bureau will be conducted, in which the Editor offers unbiased advice to those who are concerned with motor transportation, and will endeavor to answer as completely as possible any questions that may be put to him relating to mechanical features, operation and management of commercial motor vehicles. The first issue of this Department will appear in the SCIENTIFIC AMERICAN of September 21st.

Labor-Saving Devices

¶ To press a button and blow up a battleship, to swing a lever and see one hundred and fifty tons of iron lifted in the air and dropped neatly and precisely on the deck of a ship, to feed a strip of paper into one end of a printing press and to see issue at the other end in an hour 50,000 newspapers, folded and ready for distribution, these are only a few of the more obvious miracles wrought by labor-saving devices.

¶ In the October mid-month issue of the Scientific American, articles will be published on machines just as magical in their effect as these, but not so well known to the general public.

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¶ First of all there are the labor-saving machines that have given us the cheap automobile. Mr. Theodore M. R. von Keler will write about them. He will take you through an automobile factory and explain how the wonderful machine tools there installed do their work so rapidly, so efficiently that for a thousand dollars, more or less, you can buy a motor car far better than the vehicle sold for five times the money a few years ago.

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¶ An article on labor-saving devices in the home will show what the inventor has done to make housekeeping easy.

Electricity on the Farm

¶ Lastly, there will be an article by Mr. Putnam J. Bates, a well known electrical engineer, in which he will set forth how electricity may be used to reduce the farmer's labor. This will be the first of six articles Mr. Bates has written for the Scientific American on the subject of using electricity on the farm. Every one of the articles will describe an actual installation and not merely an electrician's dream.

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